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NORTHERN GREAT PLAINS RESOURCE PROGRAM, SURFACE RESOURCES WORK GROUP. REGIONAL PROFILE

Northern Great Plains Resource Program

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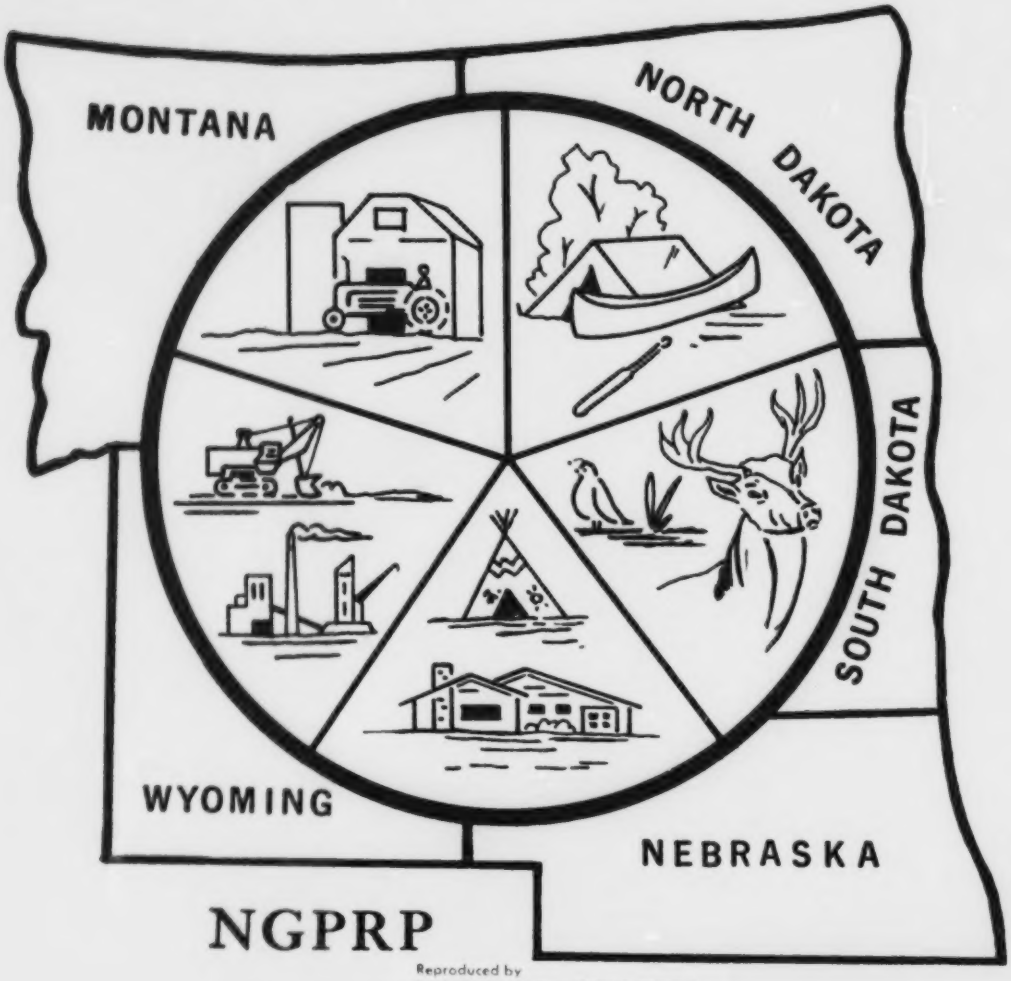

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16. Abstracts

Describes existing conditions in a 63 county area in the states of North Dakota, Montana, Wyoming and South Dakota. Includes separate detailed analyses in the areas of: 1) Land Resources, uses and ownership; 2) Soils; 3) Vegetation; 4) Fish and wildlife; 5) Recreation; 6) Agriculture; 7) Wilderness; 8) Scenery; 9) Forest products; 10) Surface rehabilitation potentials and limitations; and 11) Eco-systems relationships. Their purpose is to present data on existing conditions upon which to base analyses of potential impacts that could result from three alternative levels of coal development. These impacts analyses are included in report number NGPRP/CD-74/401.

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Northern Great Plains	Resource uses
Montana	Ownership
North Dakota	Soils
Wyoming	Vegetation
Coal	Fish and wildlife
Energy	Recreation
Impacts	Agriculture
Mining	Wilderness
Resource	Scenery
Resource descriptions	Rehabilitation

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NORTHERN GREAT PLAINS RESOURCES PROGRAM

SURFACE RESOURCES WORK GROUP - REGIONAL PROFILE

DISCUSSION DRAFT

FEBRUARY 1974

THIS REPORT WAS PREPARED PURSUANT TO A DIRECTIVE DATED OCTOBER 23, 1973, FROM THE PROGRAM MANAGER, NORTHERN GREAT PLAINS RESOURCES PROGRAM. PUBLICATION OF THE FINDINGS AND RECOMMENDATIONS HEREIN SHOULD NOT BE CONSTRUED AS REPRESENTING EITHER THE APPROVAL OR DISAPPROVAL OF THE SECRETARY OF THE INTERIOR, THE SECRETARY OF AGRICULTURE, THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY, OR THE STATES OF MONTANA, NEBRASKA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING. THE PURPOSE OF THIS REPORT IS TO PROVIDE INFORMATION AND ASSISTANCE TO THE PROGRAM MANAGEMENT TEAM IN THE PREPARATION OF THE DRAFT INTERIM REPORT ON THE NORTHERN GREAT PLAINS RESOURCES PROGRAM. THE PROGRAM MANAGEMENT TEAM IS RELEASING THIS DRAFT FOR PUBLIC USE WITHOUT CORRECTING INCONSISTENCIES OR REWRITING BECAUSE THE DELAY REQUIRED TO ACCOMPLISH THIS TASK WOULD DELAY THE TIMELY ISSUANCE OF THE REPORTS.

PREFACE

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The preparation of this voluminous report on surface resources and related topics for the Northern Great Plains Resources Program was a major effort involving personnel from federal and state agencies, universities, private industry, and conservation and environmental groups. Individuals listed below participated significantly in this effort, contributed substantially to the report, and deserve recognition. We acknowledge with appreciation their contributions. Any omissions from this list of participants is unintentional and inadvertent.

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February 1974

SURFACE RESOURCES REGIONAL PROFILE

Summary

The Northern Great Plains Resources Program is designed to provide an analytical and informational framework to the states and other administering agencies to aid in planning management alternatives for resource development, with particular attention focused on coal. A complementary objective is to provide a coordinating link for the rapid interchange of technology and methodology concerning resource management activities of the several states and agencies operating in the Northern Great Plains.

The Surface Resources Work Group was assigned résponsibility for developing a regional profile on 11 assigned resources and topics (outlined below); identifying and describing constraints affecting resource development; and analyzing the impacts on surface resources that three projected levels of coal development (forecasts) would create.

Components of the Surface Resources regional profile include:

A. Physical description

1. Land resources, uses, and ownership
2. Soils
3. Vegetation

B. Resource condition and use

1. Fish and wildlife
2. Recreation

3. Agriculture

4. Wilderness

5. Scenery

6. Forest products

C. Surface rehabilitation potentials and limitations

D. Ecosystem relationships

The Northern Great Plains Resources Program area delineated for study by the Surface Resources Work Group includes 63 counties in portions of four states (Figure 1). This area coincides with the study areas of the Mineral Resources and Regional Geology Work Groups, and approximates that of the Socioeconomic Work Group.

The regional profile is a summation of the reports by the 11 subgroups comprising the Surface Resources Work Group. Individual resource or topic reports follow this summary

Regional Profile

Salient features of the regional profile, derived from subgroup reports, follow.

The Northern Great Plains Resources Program study area encompasses nearly 92,000,000 acres, or about one-twentieth of the contiguous area of the nation--of which, only about 2 percent is covered by water.

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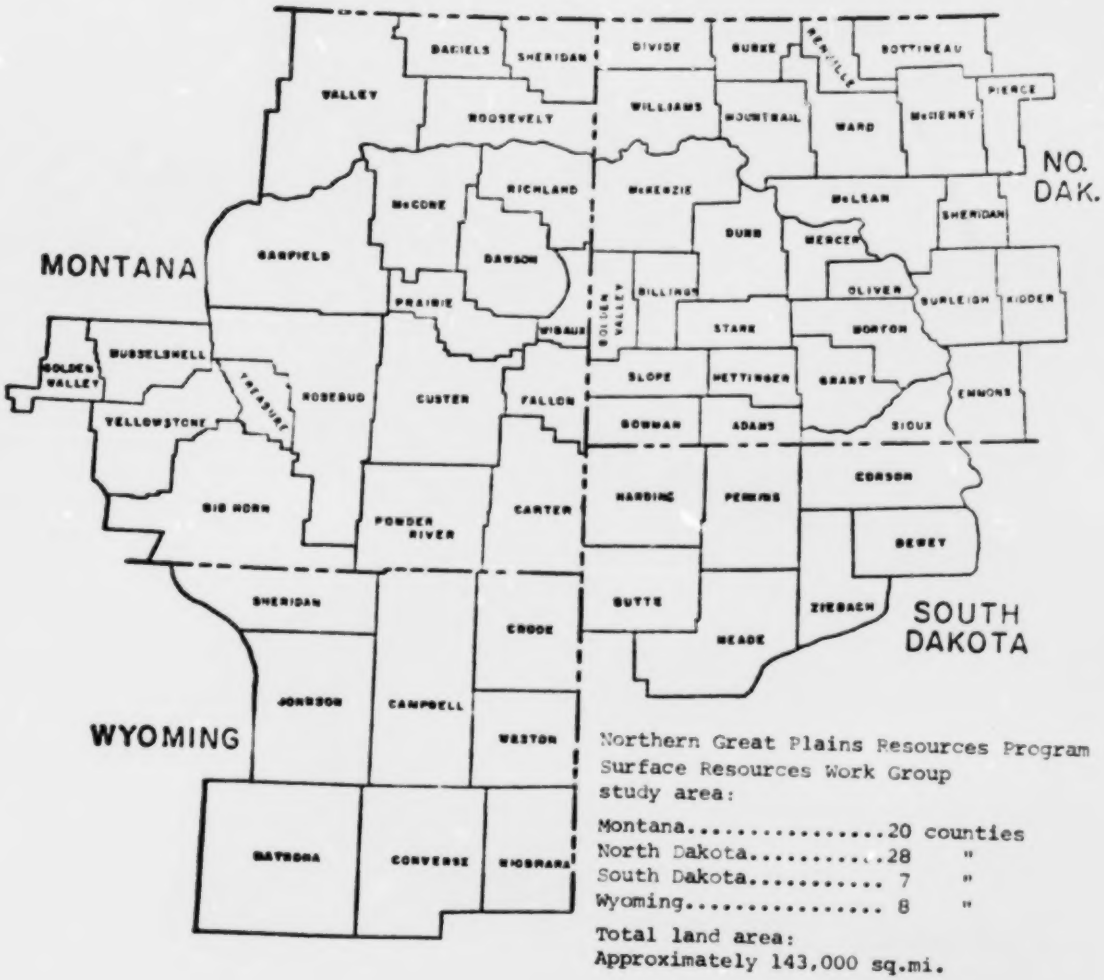
February 1974



Northern Great Plains Resources Program
Surface Resources Work Group
study area:

Montana.....20 counties
North Dakota.....28 "
South Dakota..... 7 "
Wyoming..... 8 "

Total land area:
Approximately 143,000 sq.mi.

Figure 1. Surface resources study area.

Between 1960 and 1970, the overall population of the study area declined by 1.4 percent. In 1970, the resident population was divided 50 percent urban and 50 percent rural, with an average density of 4.4 persons per square mile.

Much of the NGPRP area presents a fragmented ownership pattern of both surface and subsurface estates. Intermingled private, federal, and state lands often create complex management problems. Another problem rests in the alienation, in many instances, of the surface and subsurface estates. For example, in North Dakota, the Bureau of Land Management is responsible for surface-subsurface estates in the approximate ratio of 1 to 63.

Data show that within the NGPRP area, non-federal surface holdings account for 86.1 percent of the acreage, while federal holdings amount to 13.9 percent. Federal subsurface rights extend to 28.6 percent; the remainder is in non-federal holdings.

Forests and woodlands comprise about 4 percent of the Northern Plains area, and consist of hardwoods at lower elevations and along streams and conifers at the upper elevations. Only 24 counties have more than 10,000 acres of commercial forests.

A large part of the regional economy depends upon agriculture. Pastureland and rangeland represent the largest land use, and account for 70 percent of the area. About 26 percent of the land is cultivated, of which 2.95 percent of the cultivated cropland is irrigated.

Approximately 1.3 percent of the total study area is devoted to cities, villages, transportation networks, and other necessary built-up uses and needs.

The NGPRP study area currently has an installed electric energy production capacity of 2,469,000 kw. Thirty-six percent is hydro-generated, while 64 percent is developed from fossil fuels. Other generating plants are under construction or in the planning stage.

Rural, municipal, state, and interstate roads, public and private airports, railroads, and oil and gas pipelines comprise the transportation network.

Forty-two soil associations occur in the NGPRP study area. They represent areas whose unique combination of climate, landform, vegetation, and surficial geologic materials has resulted in a distinctive kind and pattern of soils. A wide range in kinds of soil (series) may occur in a soil association, but the soils occur in a distinctive pattern.

Narrative discussions of soil associations give a reasonably vivid and concise picture of the landscape and its soils, geology, climate, vegetation, current use, and general productivity, potentials, and limitations. Several of the most important soil properties for each of the dominant soil series and pertinent interpretations of behavior, performance, and suitabilities are presented in tabular form in the regional profile.

The soils of the study area vary widely, ranging from the gently sloping, deep, loamy soils of the glaciated northern portions to shallow, rocky, steep soils of the submountainous slopes. Some soils are very sandy . Clayey soils formed in shale are extensive. Some are cool soils having thick, black surface layers rich in organic matter; others are warm, with little organic matter enrichment. Others have high sodium contents.

Since 1940, soil surveys have been published for nine of the 63 counties in the study area. Surveys for nine other counties are expected to be published in the next 3 years.

The suitability of soils for surfacing mine spoils is treated in the report. Some soils are so shallow, sandy, clayey, or saline to render them poor surfacing material. Other soils are judged fair, while others are well suited. The definitions of good, fair, and poor suitability are based upon soil requirements for plant growth.

Information in the soils report does not replace the need for detailed onsite soil surveys and geologic studies for planning developments.

The basic inventory of information on vegetation was oriented on a soil association basis because of the intricate relation Descriptions of 36 plant communities by range sites are presented in the regional profile. The plant communities described are those thought to represent the ecological potential for the site, and do not necessarily represent the present plant communities. Each description relates the plant community to its geographic location, soil association, principal soil series, and dominant vegetal composition.

Annual forage production estimates are made. The range site's suitability as wildlife habitat and corresponding wildlife values are described. The present condition of the rangelands is estimated by percentages of the whole. Production is expressed in terms of air-dry above ground production of herbaceous plants, plus current leaves and twigs of woody plants.

Locally, many inclusions of small range sites occur within a major plant community. Where two or more range sites are included and described within a single soil association, the percentage of the area occupied by each is estimated.

A large proportion of the lands (about 70 percent) is used primarily for range. Hence, the descriptions of natural plant communities are based on rangeland interpretation. Most rangelands within the NGPRP area are better suited for their adapted uses today than they were 25 years ago because of better use and management.

Extensive portions of the Northern Great Plains Resources Program area are nationally known and important for their outstanding game hunting for deer, antelope, elk, and prairie grouse. Limited hunting for prime trophy species of bear, moose, mountain goat, and bighorn sheep occurs in several more restricted locales within the area. There is also a wide variety of upland game birds and animals. Relatively low hunting pressures provide sportsmen with an array of opportunities unequaled almost anywhere in the nation. Waterfowl resources are locally important, and extensive natural wetlands are present--especially in the northern portion of the study area. In some areas, waterfowl resources are limited by a lack of natural wetlands or developed facilities, and waterfowl hunting is of little importance. Overall, the area is recognized not only as one important for game production and hunting, but one that affords many opportunities for observation or other noncomsumptive use of an even wider range of native and introduced species. These resources are a source of appreciable income, and provide many thousands of days of recreation for both resident and nonresident participants. For these reasons, wildlife species should not be overlooked in formulating development plans; and every effort should be made to safeguard this potential.

The Northern Great Plains Resources Program area contains many miles of fishing streams, of which a substantial number of segments are classified as Class 1 of national importance or Class 2 of statewide importance. Although these and other streams currently support an impressive amount of use, the bulk of existing fishing

capacity is afforded by the variety of lakes, reservoirs, and ponds extensively distributed within the area.

A great variety of major game fish species occupy the available cold and warm water habitat. In addition, potentially valuable commercial fishery resources exist. Present use of these resources is limited because of market conditions, remoteness of markets, restrictive regulations, and the level of present technology. Nevertheless, the commercial fishery resource deserves careful consideration in development plans that would affect the operation of existing impoundments or lead to the development of additional reservoir sites.

Insects are not discussed in this collection of regional profile data. However, they are important food for many of the fish and wildlife species discussed, and are a vital cog in every ecosystem inhabited by fish and wildlife.

The scenery regional profile of the present surface condition and use as related to visual resources consists of a map indicating physical subdivisions of the study area and a narrative describing the scenic resources of each subdivision. Physical subdivisions, according to the National Atlas, are used as the basis for the report. These subdivisions include portions of the Dakota-Minnesota Drift, the North Central Lake-Swamp-Moraine Plains, Black Hills, Middle Rocky Mountains, Southern Rocky Mountains, Wyoming; Big Horn Basins and Upper Missouri Broken Lands of the Northern Great Plains.

This last and predominant subdivision is broken down into six categories of landforms.

Elements making up the scenic resources of the area are landforms resulting from natural forces on the earth's surface and land patterns resulting from man's manipulation of the surface. Observations of these elements in association with vegetative cover, water, and the presence of wildlife comprise the "scenic" value.

Three physical subdivisions are represented in Montana. The North Central Lake-Swamp-Moraine Plains in the northeast corner of the study area range from nearly level plains to hilly country, with numerous lakes and potholes. The Upper Missouri Basin Broken Lands cover most of the study with the categories of river breaks, flat open country, rolling open country, and scattered ponderosa pine country. The third subdivision, Middle Rocky Mountains, is represented by the Big Horn and Pryor Mountains.

Areas considered to have higher scenic values in the State are the Missouri River Breaks, Chalk Buttes, Bull Mountains, the southern one-half of the scattered ponderosa pine country, and the Big Horn and Pryor Mountains.

The three physical subdivisions in the study area of North Dakota include the gently rolling prairie with low hills in the Dakota-Minnesota Drift, the rolling-to-level pothole country of the North Central Lake-Swamp-Moraine Plains, and again, the dominant Upper Missouri Basin Broken Lands with river breaks, flat open country, badlands, and the Missouri Slope.

Higher scenic values are considered to be associated with lake and pothole country north and east of the Missouri River breaks, the Des Lacs River Valley, Crow Flies High Butte, and the shoreline of Lake Sakakawea between this butte and Williston, the Sentinel Butte locality, Little Missouri River Badlands, Blue Butte locality, and the Killdeer Mountains.

In South Dakota, the Upper Missouri Basin Broken Lands include river breaks and the Missouri Slope, with the Black Hills subdivision in the extreme southwest corner.

The buttes in the two northwestern counties, the vast rolling grasslands in general, and the Black Hills are considered to possess higher scenic qualities.

Five physical subdivisions are in the Wyoming portion of the study area, the largest area being the Upper Missouri Basin Broken Lands with river breaks, badlands, rolling open country, and scattered ponderosa pine country. Other subdivisions are the Black Hills-Devils Tower area, the Middle Rocky Mountains (Big Horn Mountains), the Southern Rocky Mountains (Laramie Range), and the Wyoming-Big Horn Basins.

Higher scenic values are considered to be associated with the scattered ponderosa pine country between the Powder River and Big Horn Mountains, the Black Hills area, Big Horn Mountains, and the Red Wall.

Fifty-four counties in the NGPRP area contain 2,712,010 acres of commercial forest land, but only 24 counties contain more than 10,000 acres each. Thirteen counties rather consistently report forest products output, which in 1969 aggregated 9,945,000 cubic feet. These same 13 counties contain 1,853,000 acres of commercial forest land, supporting about 2.19 billion cubic feet of growing stock.

The area and volume figures do not adequately describe the nature of the forest resources because commercial forest land is widely scattered and includes many acres capable of producing only 50 cubic feet or less per acre annually.

Sawlogs account for more than 95 percent of the volume of output. Other products include pulpwood, posts, poles, fuelwood, farm timbers, and miscellaneous industrial wood. Most sawmills produce less than 1 million board feet of lumber annually, but a few produce from 5 to 20 million board feet annually.

The most important factors that determine the probabilities for successfully rehabilitating surface mined lands in the Northern Great Plains are the amount and distribution of precipitation, the productivity and stability of soils, and the suitability and availability of different plant species. The single most important factor is the amount and distribution of precipitation.

More than 90 percent of the surface minable lands in the Northern Great Plains receives between 12 and 16 inches of precipitation annually. The distribution of average annual precipitation in relation to surface minable lands was determined and outlined on a base map.

Seventeen major soil associations occur in those areas designated as containing surface minable coal. Characteristics and interpretive functioning of these soils have been described in the soils report. The areas of these soils have been determined by counties in relation to surface minable coal.

Nine major vegetation types described in the ecosystems report are associated with the surface minable areas.

Delineating the surface minable area into precipitation zones by 1-inch increments in combination with the 17 soil associations and nine vegetation types result in 86 different combinations on the ground, each having its own rehabilitation potential. Many of these occur in more than one location, thus the NGPRP area contains a total of 146 of these tracts of land. These land units are termed "rehabilitation response units."

Each rehabilitation response unit is identified by three sets of numbers; for example, 117-6-14 is a unit on soil association 117, on grassland-sagebrush vegetation (type 6), in a 14-inch annual precipitation zone. These combined characteristics place this particular unit in east central Campbell County, Wyoming. All rehabilitation response units have been tabulated and listed by number and acreages by counties and states.

Within the NGPRP area, 15 coal surface mines and three large bentonite mines have engaged in rehabilitation research or rehabilitation action programs to some degree. The mined areas occur on

14 different rehabilitation response units, representing a wide range of conditions. A brief description of rehabilitation treatments and results are contained in the report.

The summary of rehabilitation experience and history on the major coal and bentonite surface mines in the Northern Great Plains indicates several rather common reclamation problems. Perhaps the most common is leaving spoil slopes too steep on the more unstable soil associations. Overburden conditions adverse to plant growth are often overlooked, although, in many cases, they are probably recognized. Solutions to many conditions that have been called problems in the past can be achieved by commonsense practices, together with interest in and knowledge about conditions that determine plant growth. Good rehabilitation will continue to require site specific application of sound principles of plant-soil-water relations.

To the casual observer, the NGPRP area is often viewed as a monotonous and limitless flatland occupied by "nameless grasses and sagebrush." More careful observation reveals a heterogenous physiography, anything but monotonous, and supporting a highly intricate and rich biota of enormous diversity.

The report delineates, describes, and characterizes the major ecosystems of the Northern Great Plains within certain limits. The major components of each ecosystem -- vegetation, animals, soils, physiography, and sensitivities -- have been identified. Sixteen major ecosystems are delineated and characterized. They are:

flood plain, badlands, short-grass prairie, mid-shortgrass prairie, mid-grass prairie, grassland-sagebrush, sagebrush-steppe, grassland-sandsage, mid-tall grass prairie, foothills grassland, prairie-oak savanna, ponderosa pine forest, Black Hills pine forest, Douglas-fir forest, ponderosa pine--Douglas-fir forest, and subalpine. Descriptions of each ecosystem include such elements as topography, soils, vegetation, fauna, and ecosystem interactions and limitations.

Of all the extreme climatic variables common to the Northern Great Plains, none has a greater ecological impact than that of the ubiquitous threat of drought. Despite the periodicity of its occurrence, recovery from drought in this region is very slow.

The activities of insects and micro-organisms are alluded to because of their role and vital influence in ecological phenomena. Unfortunately, not much is known about specific roles they play in ecosystem dynamics.

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LAND RESOURCES, USES, AND OWNERSHIP

I. INTRODUCTION

The Northern Great Plains Resources Program study area encompasses approximately 143,000 square miles (U.S. Census Data, 1970), consisting of nearly 92 million acres of land and water. The study area, situated within the western plains, includes 20 eastern counties in Montana, 28 western counties in North Dakota, 7 northwestern counties in South Dakota, and 8 northeastern counties in Wyoming, totaling 63 counties. This coverage accounts for about one-twentieth of the contiguous area of the nation, and occupies the Interior Plains (MBIAC, 1971) physiographic landform.

Land and water acreage statistics are presented by states in Table 1. County statistics for each state are contained in the appendix. Only about 2 percent of the entire area is covered by water.

Table 1. Land and water areas comprising the NGPRP study area 1/

State	Water area				Land area		Total area acres	Total area sq.mi.
	Over 40 acres	Under 40 acres	Total acres	Total sq.mi.	Total acres	Total sq.mi.		
Montana	461,568	54,046	515,614	805	34,100,834	53,283	34,616,448	54,088
North Dakota	716,416	107,649	824,065	1,288	25,832,575	40,363	26,656,640	41,651
South Dakota	113,984	47,535	161,519	252	11,510,161	17,985	11,671,680	18,237
Wyoming	31,424	80,455	111,879	175	18,472,441	28,863	18,584,320	29,038
TOTALS	1,323,392	289,685	1,613,077	2,520	89,916,011	140,494	91,529,088	143,014

1/ Source: Total area is derived from U.S. Bureau of Census (1970), Land and Water area. Water areas over 40 acres include streams one-eighth mile in width or more. Water areas under 40 acres are from the State Conservation Needs Inventory (1970), Soil Conservation Service, USDA.

Between 1960 and 1970, the overall population of the study area declined by 1.4 percent. In 1970, the resident population was divided 50 percent urban and 50 percent rural, with an average density of 4.4 persons per square mile.

Much of the NGPRP area presents a fragmented ownership pattern of both surface and subsurface estates. Intermingled private, federal, and state lands often create complex management problems. Another problem rests in the alienation, in many instances, of the surface and subsurface estates. For example, in North Dakota, the Bureau of Land Management is responsible for surface-subsurface estates in the approximate ratio of 1 to 63.

Data show that within the NGPRP area, non-federal surface holding account for 86.1 percent of the acreage, while federal holdings amount to 13.9 percent. Federal subsurface rights extend to 28.6 percent; the remainder is in non-federal holdings.

Forests and woodlands comprise about 4 percent of the Northern Plains area, and consist of hardwoods at lower elevations and along streams and conifers at the upper elevations. Only 24 counties have more than 10,000 acres of commercial forests .

A large part of the regional economy depends upon agriculture. Pastureland and rangeland represent the largest land use, and account for 70 percent of the area. About 26 percent of the land is cultivated, of which 2.95 percent of the cultivated cropland is irrigated. Cropland as a percent of total land area in 1970 is shown in Figure 1.

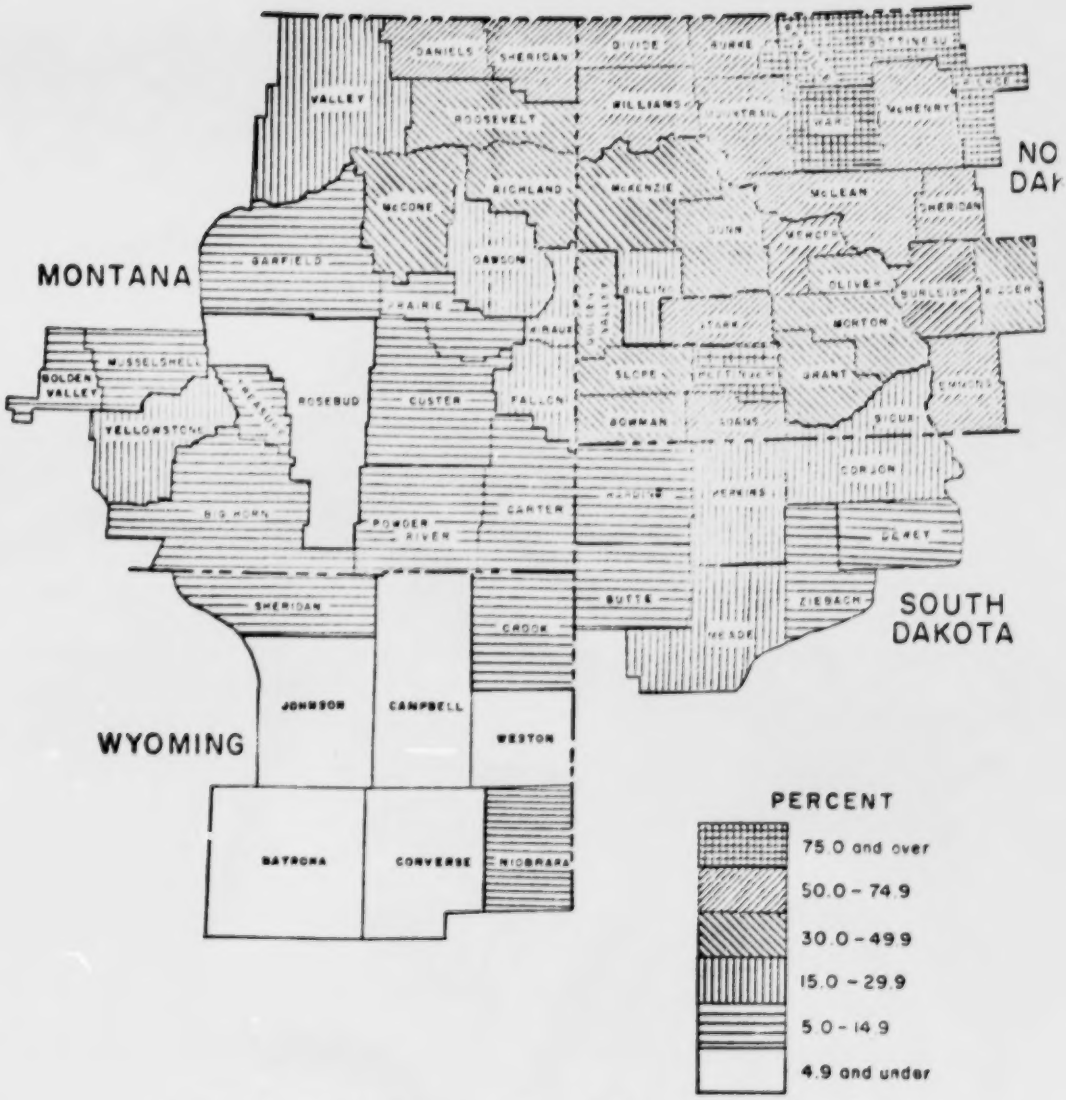

Figure 1.--Cropland as a percent of total land area in 1970.

Approximately 1.3 percent of the total study area is devoted to cities, villages, transportation networks, and other necessary built-up uses and needs.

The NGPRP study area currently has an installed electric energy production capacity of 2,469,000 kw. Thirty-six percent is hydrogenerated, while 64 percent is developed from fossil fuels. Other generating plants are under construction or in the planning stage.

Rural, municipal, state, and interstate roads, public and private airports, railroads, and oil and gas pipelines comprise the transportation network.

II. PROCEDURES

The inventory and description of the area, including the selected resources, major land uses, and the land ownership and management profiles, were developed on a county-by-county basis for Montana, North and South Dakota, and Wyoming. While much of the information is based on existing records and data, a considerable amount of data--especially concerning the ownership and management of the subsurface or mineral estate--was developed and surfaced as a direct result of this study effort.

Initially, all of the federal land management agencies, as well as all of the participating states, were contacted for information that would help portray the gross characterizations of the selected land resources of the study area. The data were collected and compiled on a county basis, utilizing the following broad categorical approach:

1. Area Description (general and physiographic descriptions)
   a. Total land area by county
   b. Total water area by county
2. General Demographic Data (county data)
   a. Historical background and trends
   b. Total populations
   c. Detailed urban and rural statistics
   d. Major cities and towns
3. Land Ownership and Management Data (surface and subsurface estate)

a. Background information and history on existing land and mineral ownership patterns

b. Ownership statistics (surface and mineral estate)

c. Management information (history and present management objectives)

(1) Non-federal (private, state, and local governments)

(2) Federal (by specific management agency)

4. Major Land Uses

a. Forestry

(1) Land area occupied by commercial forest land and noncommercial forest land

(2) Net volume of growing stock and sawtimber on commercial forest lands by county and owner groups

b. Agricultural land

(1) Cropland (irrigated and nonirrigated acreages)

(2) Pastureland and rangeland acreages

c. Urban and built-up areas (areas devoted to residential, commercial and industrial purposes (including:

(1) Acreages and trends

(2) Power production data (location, type, capacities, yearly production, future plans or trends)

(3) Transportation network (highway, air, rail, major pipelines and powerlines)

The response from the state and federal agencies was outstanding. Besides the information requested, a considerable amount of data in the form of surface land and mineral ownership descriptions and maps was volunteered by study participants. These maps and legal descriptions helped in the development of the study's regional surface and mineral status maps--the first ever compiled for this widespread regional area. In addition to the questionnaires and individual agency submittals, a primary source of data for this portion of the report was the Missouri River Basin Framework Study. Other important sources providing needed supplemental information were the U.S. Census; the Soil Conservation Service, State Conservation Needs Inventories; the U.S. Census of Agriculture; and the Bureau of Land Management's Land Office records.

III. RESULTS

Demographic Data. Historically, the settlement and economy of the Northern Great Plains has been closely oriented to its natural resources--especially its agricultural, mineral, and, to a limited extent, forestry base. Development of these resources spawned the urban and rural communities which have served the socioeconomic needs of the area. Over the years, many of the urban and rural communities developed into thriving centers, while others subsided or disappeared as their economic base waned.

This process of growth, recession, or demise was not only prevalent in the past but occurs today. Droughts, economic fluctuations, mechanization, improved transportation and communication facilities, and the general urbanization trends have all played a part in the distribution of population (MBIAC, 1971). The overall result has been an out-migration of the rural population and mixed rates of growth in the larger urban areas. Using a community size of 2,500 as a dividing point between the urban and rural classification, there were 309,622 urban (50%) and 308,286 (50%) rural residents in the region in 1970. This population distribution represents an increase of 38,226 urban residents (14.1%) and a decrease of 46,786 rural residents (13.2%) since 1960. Based upon the 1970 census, the region has an average density of 4.4 people per square mile,

varying widely from the high of 33.1 people per square mile in Yellowstone County, Montana (Billings SMSA) to the low of 0.4 people per square mile in Garfield County, Montana.

Between 1960 and 1970, the overall population of the region declined by 1.4 percent, decreasing from 626,468 persons to 617,908 (U.S. Census, 1970). Of the 63 counties delineated, 11 reflected population gains, while 52 experienced various rates of population decline. The divergent rates of growth and shifts of population within the region are summarized on a state-by-state basis in Table 2. Additional information, developed and aggregated on a county basis, is presented in the appendix.

Land Ownership and Management Data. All of the Northern Great Plains Region is within the original Louisiana Purchase of 1803. Title to the Louisiana Territory was delivered to the U.S. Government by France, thereby placing all of the area in federal ownership at the time the sale was consummated. Through sales, land grants and various homestead acts, most of the area passed into private and state ownership (MBIAC, 1971), resulting in the current land ownership status shown in Table 3.

It is apparent that past and present federal land laws and policies and, to some extent, state laws and policies concerning the disposal or retention of land, have shaped the mosaic land ownership pattern and uses so evident in the region today. From the land ownership Table 3 and the base map which graphically

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Table 2.--Urban and rural demographic data and trends for 1960 and 1970 in the NGPRP study area

State	Land area sq.mi. 1/	Total population		Density people/ sq.mi.		Percent pop. change	Rural				Urban			
							Population		Percent of total		Population		Percent of total	
		1960	1970	1960	1970	1960-1970	1960	1970	1960	1970	1960	1970	1960	1970
Montana	53,283	196,008	189,924	3.7	3.6	-3.1	93,794	81,290	47.9	42.8	102,214	108,634	52.1	57.2
North Dakota	40,363	285,242	277,168	7.1	6.9	-2.8	189,021	157,671	66.3	56.9	96,221	119,497	33.7	43.1
South Dakota	17,985	42,534	43,452	2.4	2.4	+2.2	33,808	28,875	79.5	66.5	8,726	14,577	20.5	33.5
Wyoming	28,863	102,684	107,364	3.6	3.7	+4.6	38,449	40,450	37.4	37.7	64,235	66,914	62.6	62.3
NGPRP TOTALS	140,494	626,468	617,908	4.5	4.4	-1.4	355,072	308,286	56.7	49.9	271,396	309,622	43.3	50.1

(General source: U.S. Census of Population, 1970)

1/ Land area, 1970 Census minus water areas under 40 acres which were obtained from the State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

Table 3.--Surface and subsurface (mineral estate) ownership by portions of states within the NGPRP study area

State	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	1/ State	2/ BIA	Private County Municipal	3/ Subtotal Federal	4/ BLM	5/ Nat'l Park System	6/ Dept. of Defense Corps of Engineers	6/ Dept. of Defense Military	7/ FSFWS	8/ Bur. of Recl.	9/ AMS	10/ BIA	11/ Nat'l Forest Service
Montana	Surface Acres	34,616,648	28,745,673	1,996,245	2,863,043	23,886,385	5,870,775	4,050,982	4,012	471,601		* 631,363	18,766	55,238	87,996	550,817
	%	100	83.0	5.8	8.2	69.0	17.0	11.7	--	1.4		1.8	--	.2	.3	1.6
	Subsurface Acres	34,616,648	23,206,669	1,996,245	2,750,341	18,460,083	11,409,979	9,703,474	4,012	346,619		618,831	10,662	55,228	87,996	582,957
	%	100	67.0	5.8	7.9	53.3	33.0	28.0	--	1.0		1.8	--	.2	.3	1.7
North Dakota	Surface Acres	26,656,640	24,713,264	667,145	723,475	23,322,644	1,943,376	67,145	69,711	514,030	5,370	215,899	20,837	1,119	4,012	1,035,745
	%	100	97.7	2.5	2.7	87.5	7.3	.3	.3	1.9	--	.8	.1	--	--	3.9
	Subsurface Acres	26,656,640	21,249,957	667,145	1,015,290	19,567,018	5,406,683	4,202,982	69,631	18,088	--	160,591	11,715	1,119	4,012	939,045
	%	100	79.7	2.5	3.8	73.4	20.3	15.8	.3	--	--	.6	--	--	--	3.6
South Dakota	Surface Acres	11,671,680	11,023,855	690,275	1,962,170	8,391,380	647,825	220,405	--	121,824	5,843		28,166	260	6,407	263,820
	%	100	94.4	5.9	16.6	71.9	5.6	1.9	--	1.0	.1		.2	--	.1	2.3
	Subsurface Acres	11,671,680	10,263,291	1,503,075	2,099,625	6,658,591	1,408,389	1,121,125	--	--	--		19,423	260	6,407	261,074
	%	100	87.9	12.9	18.0	57.0	12.1	9.6	--	--	--		.2	--	.1	2.2
Wyoming	Surface Acres	18,584,320	14,330,234	1,602,930		12,727,294	4,254,086	2,656,354	1,347		21	1,240	48,401			1,546,723
	%	100	77.1	8.6		68.5	22.9	14.3	--		--	--	.3			8.3
	Subsurface Acres	18,584,320	10,673,552	1,674,072		9,048,470	7,911,768	6,337,278	1,347		--	1,240	25,180			1,546,723
	%	100	57.4	8.7		48.7	42.6	34.1	--		--	--	.2			8.3
Total NGPRP Area	Surface Acres	91,529,088	78,813,026	4,956,628	5,528,688	68,327,710	12,716,062	6,994,886	75,070	1,107,463	11,234	* 848,502	127,170	56,717	98,415	3,396,605
	%	100	86.1	5.4		74.7	13.9	7.6	.1	1.2	--	1.0	.2	--	.1	3.7
	Subsurface Acres	91,529,088	65,392,469	5,792,491	5,865,256	53,734,222	26,136,619	21,364,859	74,990	364,707		789,662	66,480	56,707	98,415	3,329,799
	%	100	71.4	6.3	6.4	58.7	28.6	23.4	.1	.4		.9	.1	--	.1	3.6

* 533,887 acres jointly administered by Bureau of Land Management

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Table 3 (Cont'd)

Footnotes:

1/ State data (mineral ownership estimated for Montana and North Dakota)

a. Letter of September 27, 1973, J. D. Brunk, Executive Secretary, Department of Economic Planning and Development, Wyoming.

b. Letter of September 27, 1973, Jack Neckels, Director, North Dakota State Planning Division, North Dakota.

c. Letter of September 12, 1973, Arthur G. Wilner, Natural Resource Planner, State Planning Bureau, South Dakota.

d. Letter of September 11, 1973, Ted Clack, Program Coordinator, Human Resources Team, Montana Energy Advisory Council, Montana.

e. State of South Dakota, Department of School and Public Lands. South Dakota's Mineral Acres and How we Leave them for Oil and Gas, Bernard Linn, Commissioner, Pierre, South Dakota 57501.

2/ Acres of land owned by the Indians, the title of which is held in trust by the U.S. Government.
Letter of September 14, 1973, Wayne E. Stephens, Director Planning Support Group, Bureau of Indian Affairs, USDI, Billings, Montana.

3/ BLM unpublished data (mineral estate)

Compiled by: Bureau of Land Management, Montana State Office, Billings, Montana.

4/ BLM data compiled by: Bureau of Land Management, Montana State Office, Billings, Montana; and Bureau of Land Management, Wyoming State Office, Cheyenne, Wyoming.

5/ National Park Service Data. Letter of August 3, 1973, Ken Krabbenhoft, National Park Service, USDI, Omaha, Nebraska.

6/ Department of the Army, Corps of Engineers data. Letter of September 10, 1973, Gus J. Karabatsos, Chief, Planning Division, Missouri River Basin Division, Corps of Engineers, Department of the Army, Omaha, Nebraska.

7/ Bureau of Sport Fisheries and Wildlife data. Letter of August 31, 1973, Daniel V. Stiles, Chief, Branch of Wildlife Management, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, USDI, Washington, D.C. (588,887 acres jointly administered by BLM.)

8/ Bureau of Reclamation data. Letter of August 15, 1973, Russel W. Faus, Acting Regional Director, Bureau of Reclamation, Billings, Montana. Letter of September 5, 1973, H. H. Kelsch, Acting Assistant to Regional Director, Bureau of Reclamation, Billings, Montana.

9/ Agricultural Research Service data. Letter of September 12, 1973, Ralson R. Rhodes, Director, Agricultural Research Service, Hyattsville, Maryland.

10/ Acres of land owned by the Indians, the title of which is held in trust by the U.S. Government. Letter of September 14, 1973, Wayne E. Stephens, Director, Planning Support Group, Bureau of Indian Affairs, USDI, Billings, Montana.

11/ Forest Service data. Memorandum of October 5, 1973, William Holman, Forest Service, Region 1, USDA, Missoula, Montana.

portrays the land ownership status, two important observations are apparent: first, much of the Northern Great Plains area depicts a fragmented type of both surface and subsurface ownership pattern. Intermingled private, federal, and state lands occur throughout, often creating complex, interwoven management problems. The second observation, highly evident in the area, is the alienation--in many instances--of the surface and subsurface estate. This situation exists where the surface estate owner does not own the mineral estate or vice versa. In North Dakota, for example, the Bureau of Land Management administers or owns 67,145 surface acres of land, but administers or owns about 4,202,982 acres of mineral estate--an approximate ratio of 1 to 63. The following explanation provides insight into how this fragmented land ownership developed. During the 1800's, the "national land policy" was basically one of disposing of federal lands into non-federal ownership to encourage westward settlement and expansion. Three important laws were passed in 1862 that favored such development. First, the Homestead Act introduced the era of "free" land and provided a great impetus for westward expansion and the development of the important agricultural land base. Next, the Transcontinent Railroad Act granted the railroads a right-of-way and alternate sections of land for up to 20 miles on both sides of the right-of-way, to further encourage the development of the West and the development of a national transportation system.

The third law enacted encouraged the development of educational programs through the Land Grant College and University (Merrill) Act. In ensuing years, national aid to vocational colleges, offering advanced training in agriculture and mechanical arts, meant the transfer of thousands of acres of federal land to state governments in the Northern Great Plains Region (Zimmet, 1966). Over the years, numerous other acts of Congress--such as the Mining Laws of 1872 and the Carey Act of 1874[1/]--also speeded transfer of public lands into private or state ownership. Thus, it becomes obvious what happened in the settlement of the Northern Great Plains and in the West in general. Those lands most suited for agricultural, mineral, or townsite development were settled, while those unsuited for these uses remained in federal ownership. Land grants to the states and railroads resulted in large areas of land being transferred out of federal ownership in such a manner that much unfavorable as well as favorably situated or usable land was placed in non-federal ownership. Usually, however, the best and most productive land was settled by the private sector of our society.

1/ Authorized the President to grant each public land state a minimum of 1 million acres for irrigation, reclamation, settlement, and cultivation.

Beginning in the late 1800's, emphasis in public land policy began shifting toward retaining some lands in federal ownership. Land was withdrawn or set aside from the public domain to be used and administered as National Forest, National Parks, or similar conservation management units. The policy of reservation of lands for parks and forests did not, however, halt large-scale disposals to the private sector. Homesteading, as an example, was still a widespread means of conveying federal land into private ownership until the 1930's (PLLRC, 1970), when most land suitable for farming under existing conditions was in private ownership, and the homestead era--for all intents and purposes--came to an end. However, during the latter part of the homestead era, beginning in the early 1900's, the federal government began to reserve the subsurface or mineral estate while disposing of its surface lands. For example, the Stockraising Homestead Act of 1916 provides "that all entries made and patents issued under its provisions shall contain a reservation to the United States of all coal or other minerals in the lands so entered and patented, together with the right to prospect for, mine, and remove the same; also that the coal and other mineral desposits in such lands shall be subject to disposal by the U.S. in accordance with the provisions of the coal and mineral land laws in force at the time of such disposal (BLM, 1972). This developing policy of mineral reservations by the federal government in the

1900's, along with the land selection procedures utilized by the private sector, helped establish current land ownership pattern and some of its major inherent characteristics; i.e., fragmented or interspersed ownerships coupled with the alienated ownerships of the surface and subsurface estates. The alienation of the surface and subsurface estates is occasionally further accentuated by private sales and transactions where the entire rights are often not transferred from one owner to the next. Often, certain rights, privileges, and the mineral estate are withheld, thus contributing to the fragmenting or alienation of ownership.

Ownership. Within the non-federal ownership category, displayed in Table 3, the private sector (composed of farmers and ranchers) is the largest landowner in the region. As a group, this segment of the society controls approximately 68,327,710 surface acres of land and 53,734,222 acres of subsurface estate. Indian-owned lands are also private lands, title for which is held in trust by the United States, and for which the United States has certain management responsibilities as a trustee. Within the region, Indian-owned land accounts for 5,528,688[2/] acres of surface estate and 5,865,756 acres of subsurface ownership. State-owned lands--mainly school grants--account for 4,956,628 acres of surface ownership and 5,792,491 acres of mineral estate (MBIAC, 1971).

2/ Acres of land owned by the Indians, the title of which is held in trust by the U.S. Government.

Lands owned by the United States and administered by several federal agencies include: Bureau of Land Management--6,994,886 million acres surface estate, 21,364,859 acres subsurface estate; Forest Service--3,396,605 acres surface, 3,329,799 acres subsurface; Bureau of Sport Fisheries and Wildlife--848,502[3/] acres surface, 780,662 acres subsurface; Department of Defense--1,118,697 acres surface, 364,707 acres subsurface; Bureau of Reclamation--127,170 acres surface, 66,480 acres subsurface; National Park Service--75,070 acres surface, 74,990 acres subsurface; Agricultural Research Service, 56,717 acres surface, 56,707 acres subsurface; and the Bureau of Indian Affairs--98,415 acres surface, 98,415 acres subsurface.

Non-federal land ownership including private, state, and local ownerships accounts for 78,813,026 acres of surface ownership and 65,392,469 acres of mineral estate--or approximately 86.1 percent and 71.4 percent respectively of the regicnal total. Federally owned lands account for 12,716,062 acres of surface estate and 26,136,619 acres of mineral holdings, or, respectively, 13.9 percent and 28.6 percent of the total study area. The distribution of ownership varies by state and counties, and is compiled on a state basis in Table 3 and on a county basis in the appendix.

3/ 588,887 acres jointly administered by Bureau of Land Management.

Management Information. The management of the region's lands falls into two broad categories: non-federal and federal ownership. It is important to focus on the individual participants within each broad categorical heading and their management goals and objectives.

Non-Federal Ownership

1. Private Lands. Management of the private lands within the region is vested with thousands of individuals, corporations, and legal entities. Except for such general restrictions as taxes, zoning laws, or other land use controls, these individual managers have traditionally exercised the right to use or dispose of their land as they choose. The collective decisions of these landowners have determined, to a large extent, the present patterns of land use.

   Basically, management practices in the private sector are controlled by economic conditions and the resulting use of the private lands, in a broad sense, is the optimizing of economic benefits. Thus, the patterns of livestock raising, cropping, timber production, industry, and urbanization represent those practices offering the greatest return from the land. Over the years, however, several important trends in land management practices have been discerned. They have resulted in the consolidation of agricultural holdings and the intensification of land use and urbanization.

Consolidation of agricultural lands into fewer but larger units has been underway a long time. This consolidation has resulted in a decrease in the overall population and in the number of landowners in the rural areas. This situation has hastened the adoption of new management practices as the remaining landowners assembled adequate resources to permit major modifications and changes of their management systems. Particularly important changes have centered around mechanization, cropping practices, and conservation measures.

An important trend in private land management is the increased intensity of use of agricultural lands. The cost squeeze between rising production costs and the income received for farm products has forced agribusiness participants to increase their efficiency in order to stay in business. The result is an increasing implementation of such innovations as private irrigation, feedlot operations, and land and water conservation measures.

The last land use trend to be discussed is a result of urban expansion. The larger cities and towns are experiencing continuing growth. Although the total acreage affected is relatively small, the change is significant because of the number of landowners involved, their density, and their individual and group needs. This urbanization trend increases awareness that this lifestyle necessitates large and, often,

complicated needs for such specialized management practices as zoning, water runoff, and flood control, transportation, recreation, open space, and other related amenities.

2. State and Local Lands. State and locally owned government lands account for approximately 4,956,628 surface acres (5.4 percent) and 5,792,491 mineral acres (6.3 percent) within the study area. To a large extent, these acreages are State School grant lands where the surface estate has historically been leased by farmers and ranchers for agricultural purposes. For example, of the eight Wyoming counties within the NGPRP study area, all of the State School lands are under grazing and agricultural leases, where portions of these leases also contain some small parcels of irrigated tracts. In addition to the grazing or agricultural leases, the states can also issue mineral leases covering such widely occurring minerals as oil and gas, coal, uranium, bentonite, and sand and gravel[4/]. Mineral leasing, especially that requiring surface or strip mining, has come under widespread scrutiny, examination, or concern in all four NGPRP states.

4/ Letter of January 3, 1974, A. E. King, Commissioner of Public Lands, Wyoming.

As an example of this concern, the State Land Board of North Dakota, on November 6, 1972, adopted the following motion concerning surface mining[5/]:

> "The Board will not accept any bids, and from this moment it shall be the board's policy, not to advertise State School Lands for sale or lease for coal or other sub-surface minerals that are mined by surface mining, until the Legislature by law or resolution shall have established a policy for such sale or lease."

Federal Lands

1. National Forest System. The National Forest System in the study area is comprised of all, or parts, of four National Forests and five National Grasslands, whose area totals 3,396,605 million acres. These lands are administered by the Forest Service of the Department of Agriculture.

As directed by Congress, renewable forest resources--water, timber, forage, wildlife, and recreation--are managed under the principles of multiple use and sustained yield. Multiple use requires that resource management be coordinated so that areas of land produce a combination of values that best serve the American people. Sustained yield

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5/ Letter of December 5, 1973, R. E. Lommen, State Land Commissioner, North Dakota.

means that resources are managed to provide services and products at a level as high as can be sustained without harming the land's ability to produce. Under such management, National Forests represent the Nation's largest tangible accomplishment in federal forest resource conservation.

Water from the forests irrigates agricultural land and satisfies domestic and industrial purposes. Timber provides wood products. National Forests and National Grasslands provide habitat for big and small game animals, game birds, and fish. They also produce forage for domestic livestock. Outdoor recreation activities in the National Forests include scenic drives, wilderness travel, picnicking, camping, hiking, swimming, boating, fishing, and hunting. The public has free access except where special user fees are charged for developed recreational facilities.

Twenty-five percent of the income from the National Forests and National Grasslands goes to the states and counties where the forests are located for public roads and schools. In addition, 10 percent of the income is returned to the Forest Service for construction and maintenance of forest roads and trails. The balance of 65 percent goes to the United States Treasury.

The Forest Service gave early recognition to preservation of wilderness, and in 1924 designated specific areas as

Wilderness within the National Forests. The Wilderness Act of 1964 created the National Wilderness Preservation System, and charged the agency with studying and recommending additional lands to that system. (See Wilderness Subgroup report.)

Wilderness is an integral part of multiple use in the National Forests. Management emphasis is placed on maintaining the natural condition of each wilderness. These areas provide for a primitive unconfined experience with a measure of solitude. Mechanized equipment is not permitted, except in cases of emergency, trees are not cut, and roads and all developments--except foot and horse trails--are prohibited. Fishing, hunting, camping, hiking, and grazing of domestic livestock are permitted[6/].

2. National Resource Lands. The original public domain lands, now called National Resource Lands, are administered by the Interior Department's Bureau of Land Management. Through a framework of broad policies set by Congress, the BLM is responsible for managing the surface and subsurface resources on about 7.0 million acres within the region. The BLM also serves as the official leasing agency for federal minerals; and, therefore, shares responsibility for mineral resources underlying some 19.2 million additional acres.

The public lands are managed by a decentralized organization, with major responsibilities delegated to the field.

6/ Memorandum of October 5, 1973, William Holman, Region 1, Forest Service, USDA, Missoula, Montana.

Primary management is vested in the respective State Directors. In the Northern Great Plains Resource study area, these officials are located in Billings, Montana, and Cheyenne, Wyoming. The Montana State Director is also responsible for public lands in North and South Dakota and Minnesota. The State Director at Cheyenne is responsible for Wyoming, Nebraska, and Kansas. Field management is performed by District Managers and their staffs; five district offices with management responsibilities are in the Northern Plains area.

Within the above organizational structure, various policies expressed by Congress are carried out to stabilize the livestock industry; conserve soil and other natural resources; utilize and protect timber, mineral, and other resources; encourage such multiple uses as recreation and fish and wildlife utilization; and make lands available for urban occupancy and industrial development. Land use planning is underway on all these lands to determine the best possible combination of uses for these valuable lands and their resources.

The traditional concept of the National Resource Lands as primarily a grazing resource has undergone vast modification in recent years. Although the production of livestock forage is still an important use of the National Resource Lands,

other values, including wildlife habitat, timber production, watershed protection, minerals, and outdoor recreation, are assuming greater roles in the total management picture. A true multiple use concept is rapidly becoming reality on the National Resource Lands[7/].

3. National Park System. The National Park System, established by the Congress, comprises areas of land and water of exceptional scenic, historic, and recreational interest and value. In the National Parks, geologic features and all plant and animal life are carefully protected. The Act which established the National Park Service directs the Service to administer the areas of the parks in accordance with the fundamental purpose of conserving their scenery, wildlife, natural and historic objects, and provide for their enjoyment "in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." They are, in a sense, great outdoor museums. Only such developments are permitted as are needed for the management, protection, and administration of the areas, or are required for the comfort and convenience of those who visit them for the recreation and inspiration they offer.

7/ Submittal of October 6, 1973, James Binando, Natural Resource Specialist, Bureau of Land Management, USDI, Billings, Montana.

Animal species in the parks receive protection, subject to necessary controls. Virgin forests remain unlogged to go through their natural cycles. Grazing by domestic livestock, where permitted, is limited and strictly controlled. National Park lands, with a few exceptions specifically authorized by Congress, are not subject to mineral entry. Impoundment of lakes or streams for irrigation, hydroelectric power, or other purposes is opposed in accordance with the principle recognized when the parks and monuments were exempted from the provisions of the 1920 Federal Power Commission Act. The basic policy is to preserve nature, as created, and to provide areas for visitor appreciation and use. Three categories are used to classify park installations: natural areas, historical areas, and recreational areas.

The National Park Service administers five areas in the NGPRP area. These sites include Fort Union Trading Post National Historical Site, Devils Tower National Monument, Theodore Roosevelt National Memorial Park, Bighorn Canyon National Recreation Area, and the Custer Battlefield National Monument. Each year these attractions--covering some 75,070 acres--are enjoyed by more and more people (MBIAC, 1971).

4. Indian Reservations. The six reservations in Montana and North and South Dakota that may sustain the major impact of coal development include the Crow and its Ceded Area, Northern Cheyenne,

Fort Peck, Fort Berthold, Standing Rock, and Cheyenne River. They encompass a total of 5.6 million acres of trust land. Approximately the same number of acres of coal rights are also in Indian ownership with coal reserves amounting to billions of tons.

On some reservations, more than half of the land is owned by the tribal entity, while on others a large majority is in individual Indian allotments. The amount of Indian-owned land decreased steadily during the first 65 years of this century. Most of this alienation was through cession to the federal government or by sale to non-Indian owners who acquired fee patent status on this land. Recently, several of the tribes on the Missouri River have lost considerable acreages in the acquisition of land for the large mainstem reservoirs. Erosion of land ownership has been minimized in recent years, and some tribes are now taking specific steps to consolidate ownership, acquire key tracts of land, and stop further alienation by purchasing individual allotments which otherwise might be sold to non-Indians.

Indian reservation land ranges from high forested mountain areas in western Montana and Wyoming to semiarid grasslands as typified by several South Dakota reservations, to very fertile, irrigated valleys. The distribution of reservation lands and resident populations by states are shown in Table 4.

Table 4.--Indian residents and trust land by reservation, 1973

Reservation	State	Indian-owned land (acres)1/	Indian resident population
Crow	Montana	1,562,077	4,334
Fort Peck	Montana	961,857	6,202
Northern Cheyenne	Montana	434,420	2,926
Fort Berthold	North Dakota	420,718	2,775
Standing Rock	N.Dak., S.Dak.	846,684	4,868
Cheyenne River	South Dakota	1,405,178	4,335
Total		5,630,934	25,440

1/ Acres include lands both on and off the reservation.

This wide range in topography is associated with a wide range of land types and uses. The largest single land use is range for livestock, which accounts for 84 percent of the total of the Indian-owned land; while agricultural land consists of approximately 12 percent--of which about 6-1/2 percent is irrigated. Forest resources are important to a number of the western tribes in Montana and Wyoming, particularly the Northern Cheyenne and Crow. Forest, waste, and wildland accounts for approximately 4 percent of the Indian-owned land area.

Lands within the reservation boundaries are not subject to state jurisdiction. This places them in a peculiar status,

exempt from real property and certain other taxes, but also limits the amount of state services available. Presently, some jurisdictional issues are being raised concerning special mineral taxes. These may require resolution through the courts.

The services normally provided by local or state government in a non-Indian community are performed in a cooperative effort between the various tribes and the Bureau of Indian Affairs and other agencies. These include: (a) leasing of both tribal and individual Indian lands; (b) issuance of fee patents to individually owned lands, sold to non-Indians; (c) assistance in the sale of Indian timber; (d) mineral leasing (including oil and gas); (e) guarding against trespass; (f) development of land and water conservation programs; (g) timber and range management programs; (h) maintenance of records of land titles, sales and exchanges; and (i) collection and distribution of income from surface leases, mineral leases, timber sales, and other sources. Other activities involving cooperative assistance include economic development programs, including construction, maintenance and operation of irrigation systems and development of recreational services and areas.

Associated with the Indian lands are important water and mineral resources and rights. Because these resources and rights are critical to the area's development and the nation's

energy needs, special attention should be given the development potential and the jurisdictional aspects of the Indian land resources in the Northern Great Plains region[8/].

5. Reclamation Projects. The Bureau of Reclamation manages federal land that has been withdrawn and acquired for reclamation purposes. Multipurpose management includes management for water storage, irrigation, and municipal water supplies, recreation, fish and wildlife, power, and project-service facilities.

The operation and maintenance of the system of works, including associated lands for rights-of-way, normally is turned over to a local sponsor as soon as practicable after the project works have been tested. Periodic joint inspections with district personnel help assure attention to proper operation, maintenance, and general management of the project works and lands. Operation of power facilities and, sometimes, dams, reservoirs, supply canals, and associated lands remains with the Bureau (MBIAC, 1971).

6. Flood Control Projects. The Corps of Engineers, Department of the Army, manages certain lands acquired primarily for flood control and for water resource developments. These lands are managed for multiple purposes, that include river flow control, flood control, power development, navigation,

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8/ Letter of September 14, 1973, Wayne E. Stephens, Director, Planning Support Group, Bureau of Indian Affairs, USDI, Billings, Montana.

irrigation, municipal water supply, recreation, and fish and wildlife.

Civil work lands are also administered by the Corps of Engineers. These consist of 1,107,467 acres of land acquired primarily in fee or transferred from public domain for the construction and operation of water resource developments, mostly reservoirs. Although the basic responsibility for managing these lands rests with the Corps of Engineers, federal, state, and local governmental agencies manage portions of the area for such purposes as recreation and fish and wildlife. Some project lands are leased to private parties for agricultural purposes (MBIAC, 1971).

7. Military. Military branches of the Department of Defense own and administer such military areas as air bases, missile sites, veteran hospitals, and military cemeteries. Specific administration is by the respective Department (Army, Navy, or Air Force) that uses the land (MBIAC, 1971).

8. Agricultural Research. The Agricultural Research Service conducts research relating to the production, utilization, and marketing of agricultural products, and to the control and eradication of pests and plant and animal diseases. It also conducts research relating to quarantine and to regulatory activities in marketing of farm products. The Agricultural Research Service administers and manages several tracts of

land. These include those withdrawn from the original public domain, lands acquired under Title III of the Bankhead-Jones Farm Tenant Act (7 U.S.C. 1010 et seq.), and lands acquired otherwise for research purposes (MBIAC, 1971).

9. Fish and Wildlife. The Bureau of Sport Fisheries and Wildlife administers such tracts of federal lands and waters within the study area as National Wildlife Refuges and Ranges, National Fish Hatcheries, and Waterfowl Production Areas. Management objectives are perpetuation of fish and wildlife species and fostering the use and enjoyment of the fish and wildlife resources.

The National Wildlife Refuges and Ranges contain 784,160 acres. They are managed for migratory birds, resident wildlife, endangered species, fish, and for the public enjoyment of natural resources. A principal purpose of the fish hatcheries is to enhance sport fishing through propagation and distribution of fish. Also, the Bureau of Sport Fisheries and Wildlife administers hundreds of tracts of Waterfowl Production Areas containing 67,175 acres. The Bureau also administers miscellaneous tracts acquired for other specific fish and wildlife purposes (MBIAC, 1971).

Major Land Uses

1. Forestry. Forests and woodlands comprise approximately 4 percent of the Northern Plains. There are basically two major forest types: the hardwoods or broadleafs at the lower elevations and along stream tributaries, and the softwoods or conifers at the upper elevations (Appendix E Plate 1).

Elevation plays a major role in the distribution of forests and their species composition. In the western portion of the study area, trees seldom grow below 4,000 feet elevation above sea level, except along river bottoms. Much of the forest at elevations from 4,000 to 6,000 feet consists of low volume stands of juniper, ponderosa pine, and hardwoods, which accounts for the significant acreage of noncommercial timbered land (MBIAC, 1971). Of the total forested land, 26 percent (963,218 acres), is classified as noncommercial, while 74 percent (2,711,810 acres), is classified as commercially valuable. The commercial forests, mostly lodgepole pine and ponderosa pine stands, are located at such higher elevations as the Black Hills of South Dakota and Wyoming, the Big Horn Mountains of Wyoming, and the Bull and Wolf Mountains of eastern Montana. To some extent, 54 of the 63 counties in the region contain some acreage of commercial timber. However, if all counties with 10,000 or fewer acres of commercial forest were excluded from the total, only 24 would remain, indicating the

relative scarcity and distribution of the resource. Ownership of commercial forest lands of the region is distributed as follows: National Forests, 894,489 acres (33 percent); other state and public, 500,879 acres (18 percent); and private holdings, 1,316,442 acres or 49 percent of the total. The Forest Land Statistics for the four states are shown in Table 5, while the county subtotals are in the appendix.

2. Agriculture. Most of the economy of the region, directly or indirectly, depends upon agriculture. Pastureland and rangeland comprise the major land use, and account for 62,542,666 acres or 70 percent of the total area. About 26 percent (23,508,440 acres) of the land is cultivated, while 4 percent (3,675,028 acres) is in forest and woodland, much of which is also grazed (Table 6). Total cropland in 1970 is shown in Figure 2.

Approximately 693,637 acres, or 2.95 percent, of the cultivated croplands are irrigated (Figure 3). Irrigation is practiced mostly in the Upper Missouri, Yellowstone, and Platte-Niobrara Subbasins. The proportion of cropland declines from east to west, except where conditions are favorable for wheat production or where irrigation is practiced. As a general rule, the eastern portion of the region has the highest intensity of cultivated lands.

[illegible] Resources Program
Surface Resources Work Group

[illegible]

State & Owner Group	CFL	NCFL	Total Forest Land	Nonforest Land	Total Water Area 2/	Gross Area	Net Volume of Growing Stock on CFL Thousand Board Feet			Net Volume of Sawtimber on CFL Thousand Board Feet 1/		
							Softwood	Hardwood	Total	Softwood	Hardwood	Total
MONTANA												
National For.	257,432	20,209	277,641	273,176	--	--	101,948	1,156	103,1[illegible]	334,986	1,835	336,821
Other Public	295,153	206,236	501,389	--	--	--	354,548	18,[illegible]	373,[illegible]	1,084,339	83,231	1,167,570
Private	571,613	298,595	870,208	--	--	--	612,[illegible]	29,[illegible]	641,[illegible]	1,861,530	123,809	1,985,339
Total All Owners	1,124,198	525,040	1,649,238	32,451,596	515,614	34,616,4[illegible]	1,0[illegible]	49,135	1,11[illegible]	3,280,855	208,874	3,489,729
NORTH DAKOTA												
Other Public	45,200	* --	--	--	--	--	24	30,711	30,735	--	62,646	62,646
Private	101,600	--	--	--	--	--	54	68,201	68,255	--	141,160	141,160
Total	146,800	7,600	154,400	25,678,175	824,065	26,656,6[illegible]	76	98,912	99,[illegible]	--	203,806	203,806
SOUTH DAKOTA												
National For.	44,759	* --	--	--	--	--	25,558	--	25,558	71,585	--	71,585
Other Public	13,937	--	--	--	--	--	4,361	3,754	8,115	11,614	13,482	25,096
Private	51,999	--	--	--	--	--	23,830	10,558	34,388	66,705	36,9[illegible]	103,779
Total All Owners	110,685	44,143	154,638	11,395,523	161,519	11,671,6[illegible]	53,749	14,312	68,[illegible]	149,[illegible]	50,476	200,460
WYOMING												
National For.	592,498	194,187	786,685	760,038	--	--	948,212	8,592	956,804	3,384,264	23,073	3,407,337
Other Public	146,589	72,752	219,341	--	--	--	126,944	14,972	141,916	417,956	28,302	446,252
Private	591,230	119,496	710,726	--	--	--	558,946	64,163	623,109	1,912,825	129,457	2,042,282
Total All Owners	1,330,317	386,435	1,716,752	16,755,689	111,879	18,584,32[illegible]	1,6[illegible]	87,727	1,721,829	5,715,055	180,832	5,895,877
NORTH AREA												
National For.	894,689						1,075,718	9,748	1,085,466	3,790,835	24,908	3,815,743
Other State & Pub.	500,879						485,877	68,328	554,205	1,513,909	187,661	1,701,570
Private	1,316,442						1,195,577	173,010	1,368,587	3,841,140	431,419	4,272,559
Total All Owners	2,712,010	963,218	3,675,028	86,240,983	1,613,077	91,529,089	2,757,172	251,086	3,008,258	9,145,884	643,988	9,789,872

1/ International one-fourth-inch rule.

2/ Gross area is U.S. Bureau of Census, 1970, Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

* Data not available by ownership categories.

Source: Forest Service, USDA. Letter of July 25, 1973, Dorothy Shupe, Supervisory Statistician, Intermountain Forest and Range Experiment Station, Ogden, Utah

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Table 6.--NGPRP area agricultural land use statistics (in acres)

State	Total land area 1/	Cropland			Pastureland & rangeland acres	Forest & woodland acres	Urban and built-up areas 2/
		Total acres	Irrigated acres	Non-irrigated acres			
Montana	34,100,834	6,284,575	361,435	5,923,140	26,419,864	1,649,238	272,197
North Dakota	25,832,575	14,705,446	55,119	14,650,327	10,434,323	154,400	546,006
South Dakota	11,510,161	1,822,007	64,637	1,757,370	9,548,375	154,638	31,084
Wyoming	18,472,441	696,412	212,446	483,966	16,140,104	1,716,752	305,608
NGPRP study area	89,916,011	23,508,440	693,637	22,814,803	62,542,666	3,675,028	1,154,895

1/ Source: U.S. Bureau of the Census, 1970, as modified by State Conservation Needs Inventory.

2/ Source: Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

(Overall source: U.S. Census of Agriculture, 1969, plus published and unpublished federal agency data. Land use statistics may exceed state acreage totals due to the grazing of forested lands.)

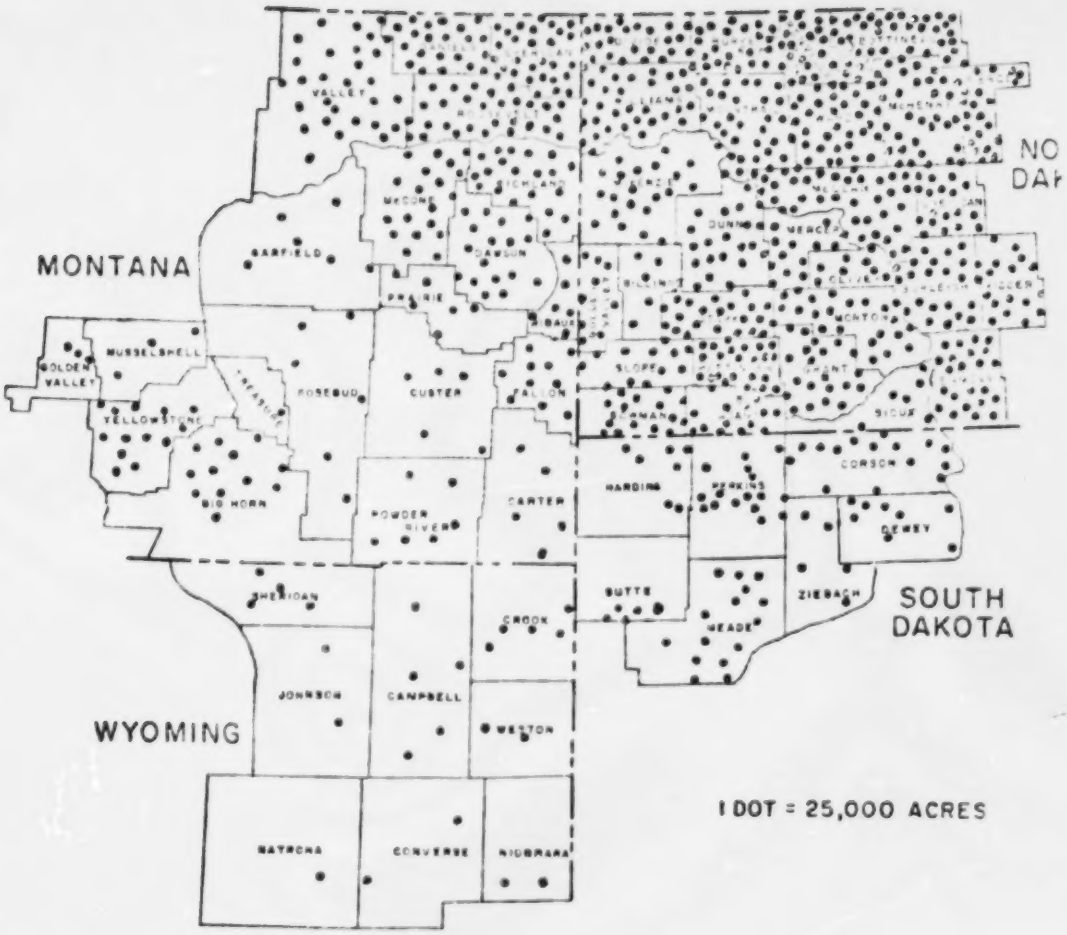

Figure 2.--Total cropland by counties within the Northern Great Plains Resources Program study area in 1970.

Figure 3.--Irrigated land in farms by counties in the Northern Great Plains Resources Program study area in 1970.

About 12.6 million acres of federally owned lands are included in the agricultural land use categories. These lands generally are located in the western portion of the region where climate, topography, soils, and the other critical agricultural requirements were less conducive to intensive development than further eastward. Most lands under federal administration, as a consequence, are in the range and forest and woodland categories.

Urban and Built-Up Areas. A small significant percentage of the land area in the region is relegated to residential, commercial, and industrial purposes. Currently, about 1,154,895 acres in this category serve a total population of 617,908 people. This represents approximately 1.3 percent of the total regional area, which is devoted to cities, villages, transportation networks, and a host of other necessary urban and built-up area uses and needs. From 1958 to 1967, land devoted to urban and built-up areas in the Northern Great Plains region expanded from 909,212 acres to 1,154,895 acres, an increase of 27 percent (Table 7 and appendix).

Table 7.--Urban and built-up area statistics in the NGPRP area

State	Acreage Total urban and built-up areas 1958	1967	Percent change 1958-1967
Montana	309,291	272,197	-11.99
North Dakota	509,421	546,006	+ 7.18
South Dakota	28,700	31,084	+ 8.31
Wyoming	61,800	305,608	+394.51
Total NGPRP area	909,212	1,154,895	+27.02

(Source: Conservation Needs Inventories, 1970, Soil Conservation Service, USDA).

Power Production. The major suppliers of electric energy in the region all have transmission systems to plants in adjacent areas, so the question of installed capacity is somewhat academic. However, from the standpoint of land use and resource utilization generated from the attendant facilities, these data and their ramifications are important. The present installed generating capacity of the region is shown in Table 8.

Data in the table show that, of the power production capacity of the region, 889,000 kw, or 36 percent, is hydrogenerated while 1,570,000 kw, or 64 percent, is thermal or fossil fuel generated. The NGPRP study area currently possesses a total installed generator capacity of 2,469,000 kw. This generated power is

Table 8.--Electric power production data by states for the NGPRP study area

Name of operation & producer	Location (county)	Installed capacity generator nameplate Kw	Yearly production capacity Kw.hrs.X 10^6	Fuel or method of generating power	Powerlines 69 kv & larger in miles
					State totals
MONTANA					
Yellowtail (Bureau of Reclamation)	Big Horn	250,000	980	Hydro	--
Fort Peck (Corps of Engineers)	Valley	165,000	890	Hydro	--
Bird & Corette (Montana Power Company)	Yellow-stone	242,000	2,115	Coal	--
Lewis & Clark (Mont-Dakota Utilities Co.)	Richland	50,000	435	Coal	--
Montana totals		707,000	4,420		1,405
NORTH DAKOTA					
Heskett (Mont-Dakota Utilities Co.)	Morton	100,000	875	Coal	--
Garrison (Corps of Engineers)	Mercer	400,000	2,055	Hydro	--
Stanton (United Power Associates)	Mercer	172,000	1,500	Coal	--
Leland Olds (Basin Electric)	Mercer	240,000	2,100	Coal	--
Center (Young) Minnkota	Oliver	235,000	2,050	Coal	--

Table 8 (Cont'd)

Name of operation & producer	Location (county)	Installed capacity generator nameplate Kw	Yearly production capacity Kw.Hrs.X 10^6	Fuel or method of generating power	Powerlines 69 kv & larger in miles State totals
NORTH DAKOTA (cont'd)					
W. J. Neal (Central Power Electric Coop.)	McHenry	38,000	330	Coal	--
North Dakota totals		1,185,000	8,910		1,760
South Dakota totals		--	--		715
WYOMING					
Dave Johnson (Pacific Power & Light Co.)	Converse	457,000	4,000	Coal	--
Fremont Canyon (Bureau of Reclamation)	Natrona	48,000	235	Hydro	--
Alcova (Bureau of Reclamation	Natrona	36,000	115	Hydro	--
Osage (Black Hills Power & Light)	Weston	36,000	310	Coal	--
Wyoming totals		577,000	4,660		1,560
NGPRP study area totals		2,469,000	17,990		5,440

Sources:

Letter of September 10, 1973, Gus J. Karabatsos, Chief, Planning Division, Missouri River Division, Corps of Engineers, Department of the Army, Omaha, Nebraska.

Letter of August 20, 1973, L. W. Lloyd, Regional Supervisor of Power, Upper Missouri Region, Bureau of Reclamation, USDI, Billings, Montana.

distributed via 5,440 miles of major transmission lines which dissect 50 of the 63 counties under study (Figure 4). Additional power production facilities are currently being developed within the region. These will modify or add to the current distribution pattern. Those projects in the active planning or development stage are:

a. Colstrip, Montana: 2,100,000 kw power plant, by the Montana Power Company and other northwest utilities.

b. Wyodak (Gillette), Wyoming: 330,000 kw power plant, by Black Hills Power & Light and Pacific Power & Light Companies.

c. Stanton, North Dakota: 400,000 kw power plant, by Basin Electric Power Cooperative.

d. Center, North Dakota: 400,000 kw power plant, by Minnkota - Minnesota-Dakota Power & Light Co.

e. New Underwood, North Dakota: 900,000 kw power plant, by Central Power Associates and United Power Associates[9/].

Transportation. Development of the region's resources to help meet national, state, and local needs has helped create the present network of municipalities, industries, and interconnecting transportation systems. Transportation systems and their associated components are an integral thread of the socioeconomic fabric of the study area. As of 1970, the approximate 88,565 miles of rural and municipal road in the region represented an overall increase of 2.4 percent since 1960. There were 100 public airports

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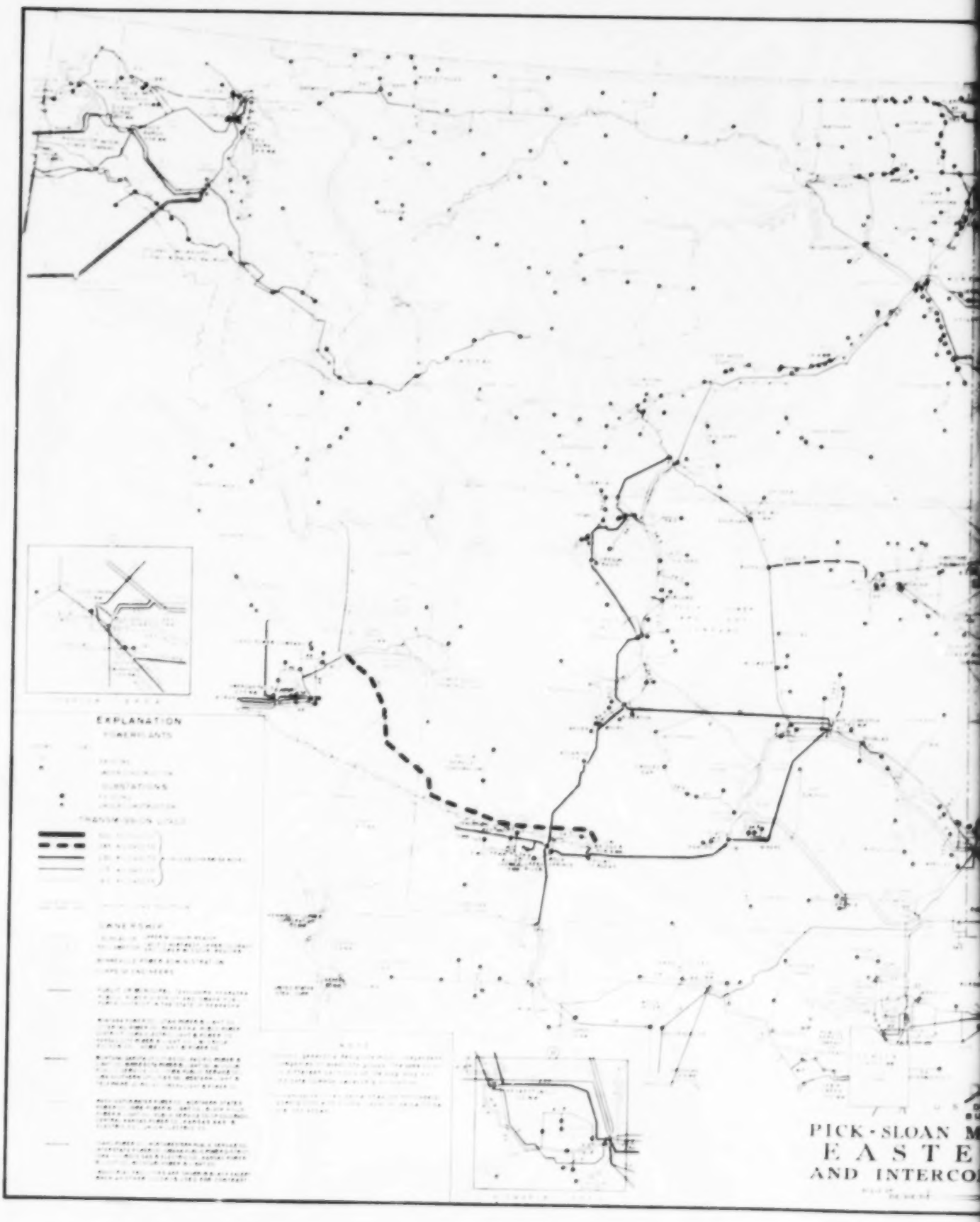
9/ Letter of August 20, 1973, L. W. Lloyd, Regional Supervisor of Power, Upper Missouri Region, Bureau of Reclamation, USDI,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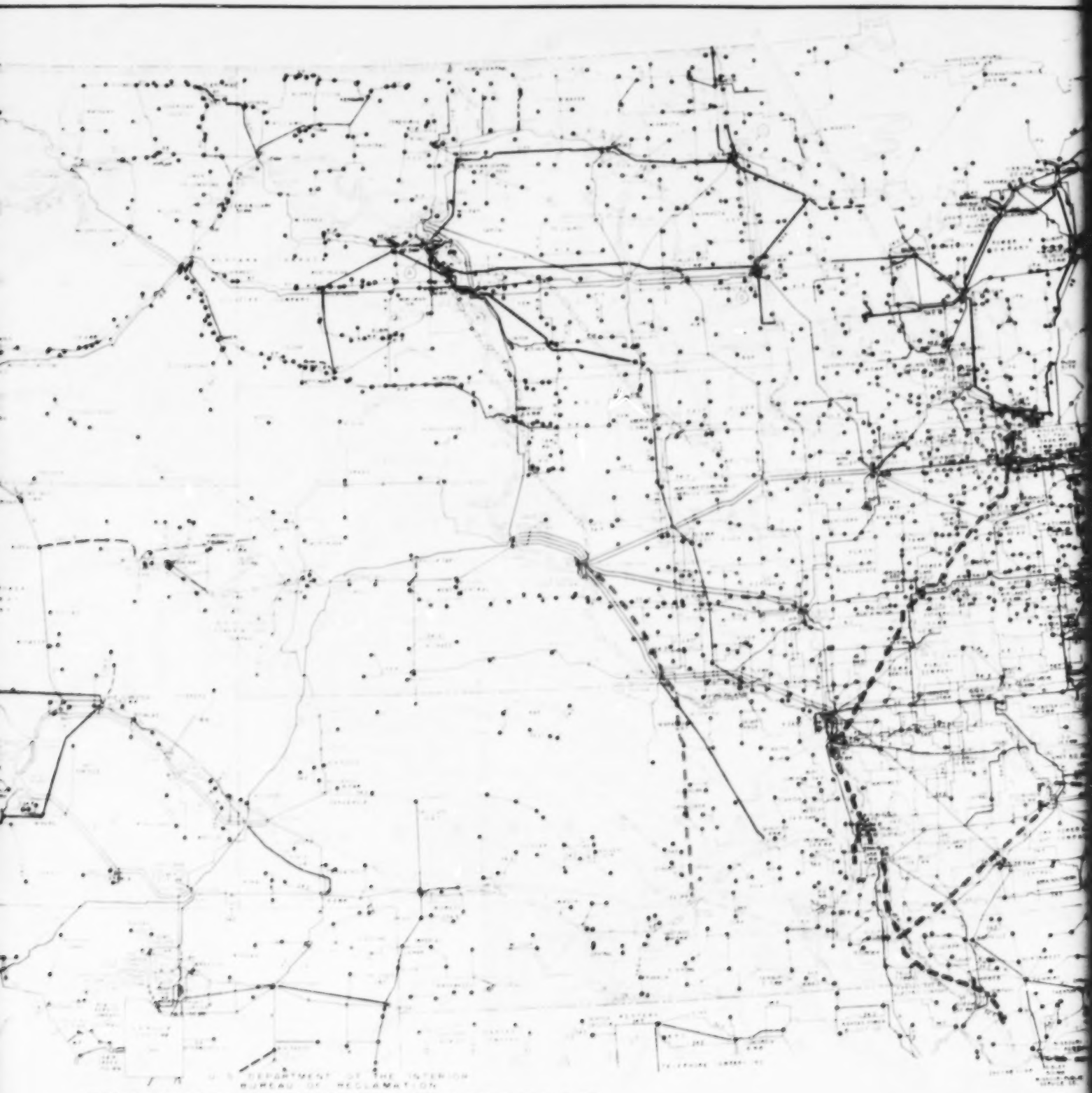

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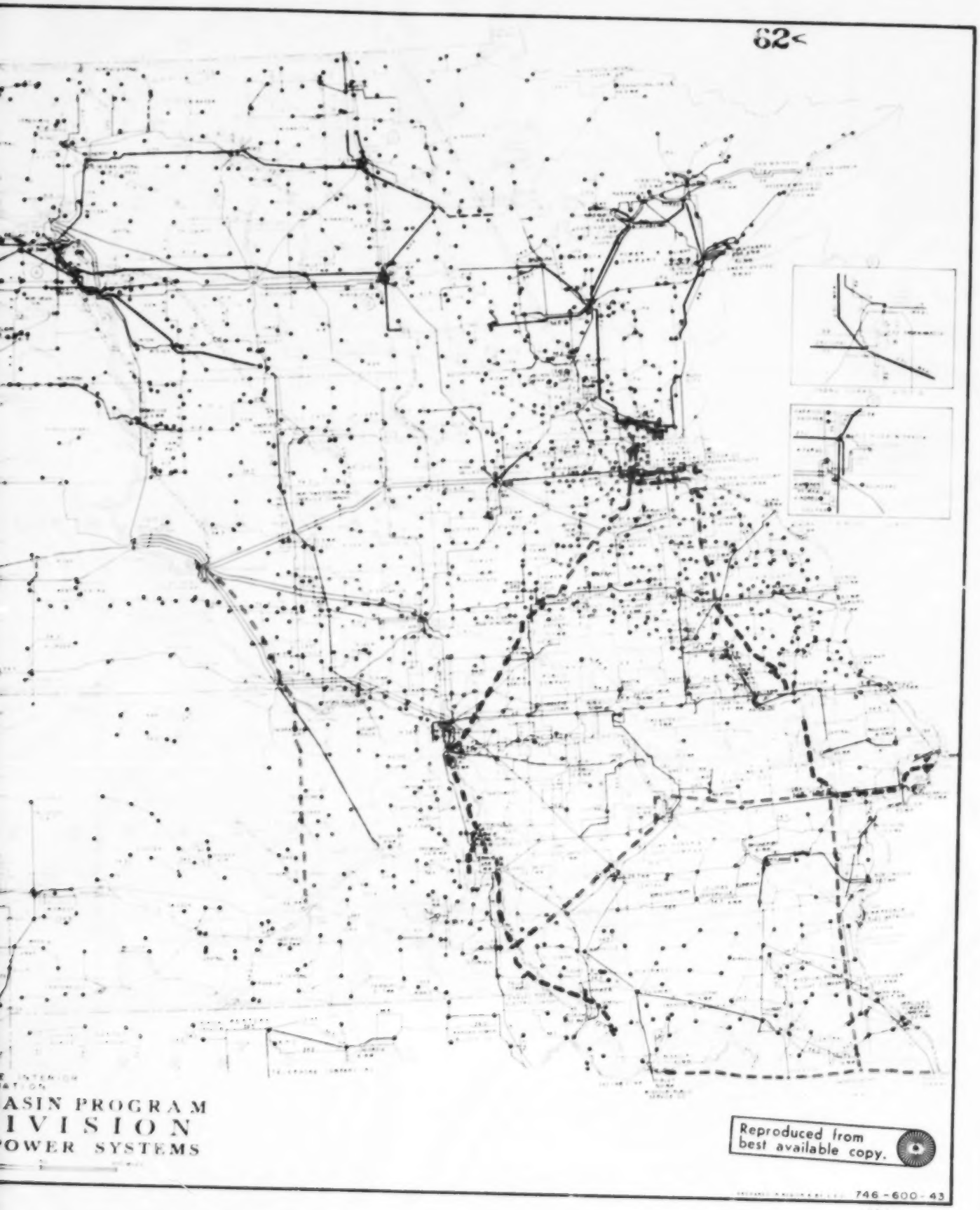
EASTERN DIVISION
AND INTERCONNECTED POWER SYSTEMS

JULY 1974



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serving 55 of the 63 Northern Great Plains counties. These public facilities were supplemented by 187 private airports located in 55 of the counties. To complete the transportation scenario, there are presently 4,996 miles of railroad lines, with 165 designated stations serving 58 of the 63 counties (Table 9).

Another important mode of transportation is the region's pipelines. Approximately 7,421 miles of oil and gas pipelines crisscross the study area. The location and size of these lines are noted in Appendix B Plate 8. Detailed statistics on a county basis are in the Appendix, and address not only oil and gas pipelines but such other important transportation components as roads and streets, airports, and railroad facilities discussed previously.

Table 9.--Components of the transportation network serving the NGPRP study area

STATE	ROADS AND STREETS: NET CONSTRUCTED MILES: TOTAL	ROADS AND STREETS: NET CONSTRUCTED MILES: RURAL	ROADS AND STREETS: NET CONSTRUCTED MILES: MUNICIPAL	ROADS AND STREETS: NET CHANGE: MILES	ROADS AND STREETS: NET CHANGE: %	TOTAL NUMBER AIRPORTS: PUBLIC	TOTAL NUMBER AIRPORTS: PRIVATE	RAILROADS: MILES OF LINE	RAILROADS: NO. OF STATIONS	MAJOR OIL AND GAS PIPELINES NET CONSTRUCTED MILES 1/
Montana	25,833	25,143	690	-1,099	-4.1	31	43	1,459	54	1,990
North Dakota	43,417	42,037	1,380	+3,628	+9.1	47	115	2,694	95	2,342
South Dakota	9,525	9,381	144	-2,441	-20.4	15	4	280	4	239
Wyoming	9,790	9,455	335	+1,953	+24.9	7	25	563	12	2,860
NGPRP Study Area Totals	88,565	86,016	2,549	+2,041	+2.4	100	187	4,996	165	7,421

1/ Data compiled by the Bureau of Land Management, Montana State Office, from U.S. Geological survey maps.

Sources:
Letter of August 22, 1973, Walter R. Hjelle, Highway Commissioner, North Dakota State Highway Department.
Letter of August 21, 1973, Robert E. Champion, P.E., Right-of-Way Section, Montana Department of Highways.
Letter of September 27, 1973, J. D. Brunk, Executive Director, Department of Economic Planning & Development, Wyoming.
Letter of September 12, 1973, Arthur G. Wilner, Natural Resources Planner, State Planning Bureau, South Dakota

BIBLIOGRAPHY

Department of Commerce, Bureau of the Census

1970. 1970 Census Data. Govt. Print. Office, Washington, D.C. 20402.

Missouri Basin Inter-Agency Committee

1971. The Missouri River Basin Comprehensive Framework Study. Vol. 6. Govt. Print. Office, Washington, D.C. pp. 15-17, 21-24, and 26-27.

Missouri Basin Inter-Agency Committee

1971. The Missouri River Basin Comprehensive Framework Study. Vol. 1. Govt. Print. Office, Washington, D.C. pp. 5 and 21.

Montana State Bureau of Land Management Office

1972. Decker-Birney Resource Inventory Questionnaire. 316 No. 26th St., Billings, Mont. 59101.

Public Land Law Review Commission

1970. One third of the nation's land. Govt. Print, Office, Washington, D.C. 20402.

Soil Conservation Service

1970. Montana Soil and Water Conservation Needs Inventory. Bozeman, Mont. 59715.

Soil Conservation Service

1970. South Dakota Conservation Needs Inventory. P. O. Box 1357, Huron, So. Dakota 57350.

Soil Conservation Service

1970. Wyoming Conservation Needs Inventory. Casper, Wyo.

U.S. Department of Agriculture

1969. U.S. Census of Agriculture.

Steven Zimmet

1966. The public domain, its place in our history, the place today, its place in our future. Govt. Print. Office, Washington, D.C.

A P P E N D I X I

LAND RESOURCES, USES, AND OWNERSHIP

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APPENDIX I

Table 1.--Land and water areas of states within NGPRP study area

STATE	WATER AREA				LAND AREA		TOTAL AREA	TOTAL AREA
	Over 40 Acres	Under 40 Acres	Total Acres	Total Sq. Mi.	Total Acres	Total Sq. Mi.	Acres	Sq. Mi.
Montana	461,568	54,046	515,614	805	34,100,834	53,283	34,616,448	54,088
% of Total NGPRP Area	35%	19%	32%		38%	38%	38%	38%
North Dakota	716,416	107,649	824,065	1,288	25,832,575	40,363	26,656,640	41,651
% of Total NGPRP Area	54%	37%	51%		29%	29%	29%	29%
South Dakota	113,984	47,535	161,519	252	11,510,161	17,985	11,671,680	18,237
% of Total NGPRP Area	9%	16%	10%		13%	13%	13%	13%
Wyoming	31,424	80,455	111,879	175	18,472,441	28,863	18,584,320	29,038
% of Total NGPRP Area	2%	28%	7%		20%	20%	20%	20%
(NGPRP Area) Totals	1,323,392	289,685	1,613,077	2,520	89,916,011	140,494	91,529,088	143,014
%	100%	100%	100%		100%	100%	100%	100%

Source: Total area is U.S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8 mile width or more. Water areas under 40 acres are from the State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

APPENDIX 1

Table 1 (Cont'd)

State: Montana

COUNTY	WATER AREA				LAND AREA		TOTAL AREA	TOTAL AREA
	Over 40 Acres	Under 40 Acres	Total Acres	Total Sq. Mi.	Total Acres	Total Sq. Mi.	Acres	Sq. Mi.
Big Horn	20,480	700	21,180	33	3,214,020	5,027	3,235,2[illegible]	[illegible]
Carter	128	5,809	5,937	9	2,114,383	3,304	2,120,[illegible]	[illegible]
Custer	11,901	9,088	20,989	33	3,394,948	5,742	3,415,9[illegible]	[illegible]
Daniels	--	1,974	1,974	3	921,482	1,440	923,456	1,443
Dawson	6,600	1,478	8,078	13	1,515,122	2,367	1,523,200	2,379
Fallon	128	1,540	1,668	3	1,043,482	1,630	1,045,1[illegible]	1,633
Garfield	229,608	3,000	232,608	362	2,844,072	4,450	3,079,6[illegible]	4,812
Golden Valley	2,304	701	3,005	5	752,195	1,175	755,200	1,180
McCone	28,800	4,722	33,522	52	1,663,758	2,600	1,697,280	2,652
Musselshell	64	1,485	1,549	2	1,266,195	1,885	1,267,744	1,887
Powder River	6,528	1,600	8,128	13	2,102,528	3,285	2,110,656	3,298
Prairie	5,504	1,029	6,533	10	1,106,364	1,729	1,112,896	1,738
Richland	15,040	4,400	19,440	30	1,326,416	2,073	1,345,856	2,103
Roosevelt	8,768	2,768	11,536	18	1,523,696	2,381	1,535,232	2,399
Rosebud	7,456	3,104	6,560	10	3,220,320	5,032	3,226,88[illegible]	[illegible]
Sheridan	16,384	2,976	19,360	30	1,081,376	1,690	1,100,736	1,720
Treasure	7,552	1,185	8,737	14	629,343	983	638,080	997
Valley	83,520	4,504	88,024	138	3,178,600	4,966	3,266,624	5,104
Wibaux	576	1,288	1,864	3	568,376	888	570,240	891
Yellowstone	15,424	500	15,924	24	1,690,188	2,641	1,706,112	2,665
TOTALS	461,568	54,046	515,614	805	34,100,834	53,283	34,616,448	54,088

Source: Total area is U.S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8 mile width or more. Water areas under 40 acres are from the State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

Table 1 (Cont'd)

State: North Dakota

COUNTY	WATER AREA				LAND AREA		TOTAL AREA	TOTAL AREA
	Over 40 Acres	Under 40 Acres	Total Acres	Total Sq. Mi	Total Acres	Total Sq. Mi.	Acres	Sq. Mi
Adams	512	150	662	1	632,938	989	633,600	990
Billings	--	1,616	1,616	3	727,344	1,136	728,960	1,139
Bottineau	19,072	5,850	24,922	39	1,067,558	1,668	1,092,480	1,707
Bowman	64	150	214	--	748,586	1,170	748,800	1,170
Burke	6,592	10,702	17,294	27	705,266	1,102	722,560	1,129
Burleigh	31,808	1,695	33,503	52	1,038,497	1,623	1,072,000	1,675
Divide	4,672	251	4,923	8	831,557	1,299	836,480	1,307
Dunn	56,832	--	56,832	89	1,275,008	1,992	1,331,840	2,081
Emmons	35,776	9,456	45,232	71	952,528	1,488	997,760	1,559
Golden Valley	--	--	--	--	648,960	1,014	648,960	1,014
Grant	3,968	2,455	6,423	10	1,063,657	1,662	1,070,080	1,672
Hettinger	384	11	395	1	726,005	1,134	726,400	1,135
Kidder	46,336	3,454	49,790	78	865,410	1,352	915,200	1,430
McHenry	15,808	6,091	21,899	34	1,196,661	1,870	1,218,560	1,904
McKenzie	68,480	--	68,480	107	1,750,400	2,735	1,818,880	2,842
McLean	167,680	6,095	173,775	271	1,315,505	2,056	1,489,280	2,327
Mercer	43,840	956	44,796	70	665,604	1,040	710,400	1,110
Morton	15,232	868	16,100	25	1,228,060	1,919	1,244,160	1,944
Mountrail	67,136	4,195	71,331	111	1,160,029	1,813	1,231,360	1,924
Oliver	5,248	493	5,741	9	460,819	720	466,560	729
Pierce	28,864	8,755	37,619	59	655,501	1,024	693,120	1,083
Renville	9,408	608	10,016	16	566,624	885	576,640	901
Sheridan	10,496	10,792	21,288	33	621,912	972	643,200	1,005
Sioux	19,328	5,208	24,536	38	700,584	1,095	725,120	1,133
Slope	832	1,449	2,281	4	782,359	1,222	784,640	1,226
Stark	1,856	4,043	5,899	9	838,261	1,310	844,160	1,319
Ward	8,960	17,791	26,751	42	1,290,369	2,016	1,317,120	2,058
Williams	47,232	4,515	51,747	81	1,316,573	2,057	1,368,320	2,138
TOTALS	716,416	107,649	824,065	1,288	25,832,575	40,363	26,656,640	41,631

Source: Total area is U.S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8 mile width or more. Water areas under 40 acres are from the State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

APPENDIX I

Table 1 (Cont'd)

State: South Dakota

COUNTY	WATER AREA				LAND AREA		TOTAL AREA	TOTAL AREA
	Over 40 Acres	Under 40 Acres	Total Acres	Total Sq. Mi	Total Acres	Total Sq. Mi	Acres	Sq. Mi
Ruffe	10,560	6,200	16,760	26	1,433,480	2,240	1,450,240	2,266
Corson	47,117	7,200	54,317	77	1,575,723	2,459	1,623,040	2,536
Dewey	50,104	7,400	57,504	90	1,501,176	2,347	1,559,680	2,437
Harding	540	12,144	12,684	20	1,704,296	2,663	1,717,120	2,683
Meade	444	7,304	7,748	12	2,210,492	3,454	2,218,240	3,466
Perkins	5,776	7,053	12,829	17	1,803,511	2,849	1,816,340	2,866
Ziebach	1,344	5,190	6,534	10	1,261,586	1,973	1,268,120	1,983
TOTALS	113,984	47,535	161,519	252	11,510,162	17,985	11,671,680	18,237

Source: Total area is U.S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8 mile width or more. Water areas under 40 acres are from the State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

Table 1 (Cont'd)

State: Wyoming

COUNTY	WATER AREA				LAND AREA		TOTAL AREA	TOTAL AREA
	Over 40 Acres	Under 40 Acres	Total Acres	Total Sq. Mi.	Total Acres	Total Sq. Mi.	Acres	Sq. Mi.
Campbell	320	10,239	10,559	17	3,033,281	4,739	3,043,840	4,756
Converse	896	11,095	11,991	19	2,729,173	4,264	2,741,120	4,283
Crook	9,728	11,060	20,788	32	1,833,292	2,865	1,854,080	2,897
Johnson	2,688	13,509	16,197	25	2,658,363	4,154	2,674,560	4,179
Natrona	17,088	8,965	26,053	41	3,410,107	5,328	3,436,160	5,369
Niobrara	--	10,065	10,065	16	1,662,895	2,598	1,672,960	2,614
Sheridan	--	6,620	6,620	10	1,613,860	2,522	1,620,480	2,532
Weston	704	8,902	9,606	15	1,531,514	2,393	1,541,120	2,408
TOTALS	31,424	80,455	111,879	175	18,472,441	28,865	18,584,320	29,025

Source: Total area is U.S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8 mile width or more. Water areas under 40 acres are from the State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

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COUNTY	1 [illegible] Seat & Pop.	1 [illegible] 2/ [illegible]	[illegible] Sq.Mi.	TOTAL POP.	[illegible] People/ Sq.Mi.	[illegible] % Change 1960-1970	URBAN POP.	% OF TOTAL	RURAL POP.	% OF TOTAL	[illegible] TOWNS & CITIES [illegible] & POPULATION
Big Horn	Hardin 2,733	3,216,020	5,052	[illegible] 36,067	7.0	8.5	[illegible] 5,435	72.8	2,733 2,733	27.2	Hardin 2,733; Lodge Grass 806
Carter	Ekalaka 9,003	2,115,383	3,995	[illegible] 1,696	0.6	-21.5	2,993 1,696	100	---	---	Ekalaka 663
Custer	Miles City 1,606	3,195,958	3,792	13,223 37,135	[illegible]	-5.0	3,563 3,151	25.9	9,663 9,023	74.1	Miles City 9,023; Ismay 40
Daniels	Scobey 6,305	921,882	1,440	2,755 3,083	2.1	-17.9	2,755 1,083	100	---	---	Scobey 1,656; Flaxville 185
Dawson	Glendive 2,594	1,515,127	2,367	12,153 11,288	4.8	-8.5	(5,234) 5,066	44.1	(7,058) 6,305	55.9	Glendive 5,305; Richey 389
Fallon	Baker 529	1,053,652	1,630	3,987 4,050	2.5	1.3	(1,901) 1,466	36.2	2,584	63.8	Baker 2,584; Plevna 189
Garfield	Jordan 261	2,868,023	4,650	1,981 1,796	0.4	-9.3	(1,981) 1,796	100	---	---	Jordan 529
Golden Valley	Ryegate 964	352,125	1,175	1,203 931	0.8	-22.6	(1,203) 931	100	---	---	Ryegate 261; Lavina 169
McCone	Circle 2,116	1,693,758	2,803	3,321 2,875	1.1	-13.4	(3,321) 2,875	100	---	---	Circle 964
Musselshell	Roundup 749	1,708,195	1,885	4,869 3,736	2.0	-23.6	(7,066) 3,736	100	2,847) ---	---	Roundup 2,116; Melstone 227
Powder River	Broadus 870	2,102,528	3,285	3,455 2,862	0.9	-15.2	(7,485) 2,862	100	---	---	Broadus 799
Prairie	Terry 4,543	1,106,364	1,729	3,384 1,752	1.0	-26.4	(3,384) 1,752	100	---	---	Terry 870
Richland	Sidney 3,095	1,326,616	2,073	10,563 9,837	4.7	-6.8	(5,909) 5,285	53.8	(4,563) 4,553	46.2	Sidney 4,543; Fairview 956
Roosevelt	Wolf Point 1,873	1,523,606	2,381	11,731 10,365	4.4	-11.6	(8,366) 7,270	70.1	(3,585) 3,095	29.9	Wolf Point 3,095; Poplar 1389; Culbertson 821
Rosebud	Forsyth 2,381	3,220,310	5,032	6,373 6,032	1.2	-2.5	(6,387) 6,032	100	---	---	Forsyth 1,873
Sheridan	Plentywood 373	1,081,376	1,630	6,455 5,779	3.4	-10.5	(6,455) 5,779	100	---	---	Plentywood 2,381; Medicine Lake 393; Westby 297
Treasure	Hysham 4,700	629,343	983	1,373 1,069	1.1	-20.5	(1,365) 1,069	100	---	---	Hysham 373
Valley	Glasgow 644	3,178,600	4,966	17,000 11,421	2.3	-32.8	(10,682) 6,771	59.0	(6,398) 4,700	41.0	Glasgow 4,700; Nashua 513; Opheim 306
Wibaux	Wibaux	568,376	888	(1,698) 1,465	1.6	-13.7	(1,698) 1,465	100	---	---	Wibaux 644
Yellowstone	61,581 Billings	1,690,188	2,641	(79,016) 87,367	33.1	10.6	(13,703) 11,716	13.4	(65,313) 75,651	[illegible]	Billings 61,581; Laurel 4,454; Broadview 123

1/ Land Area 1970 census data minus water areas under 40 acres which were obtained from the State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA. General Source: U.S. Census of Population, 1970

APPENDIX I

Table [illegible] (20)

STATE: [illegible]

COUNTY	COUNTY SEAT & POP.	LAND AREA 1/ Acres	LAND AREA 1/ Approx. Sq.Mi.	TOTAL POP.	DENSITY People/ Sq.Mi.	PERCENTAGE % Change 1960-1970	RURAL POP.	% OF TOTAL	URBAN POP.	% OF TOTAL	MAJOR TOWNS & CITIES NAME & POPULATION
Adams	Hettinger 1,655	632,938	989	(3,532) 3,532	3.9	-13.9	(3,532) 3,532	100	---	---	Hettinger 1,655; Reeder 308; Haynes 53
Billings	Medora 129	727,344	1,136	(1,513) 1,198	1.1	-20.8	(1,513) 1,198	100	---	---	Medora 129
Bottineau	Bottineau 2,340	1,067,550	1,668	(11,355) 9,606	5.7	-15.1	(8,292) 6,926	70.9	(2,613) 2,680	29.1	Bottineau 2,340; Westhope 705; Willow City 433
Bowman	Bowman 3,762	716,566	1,120	(4,155) 3,991	3.3	-6.1	(4,155) 3,991	100	---	---	Bowman 3,762; Scranton 369; Rhame 204
Burke	Bowbells 1,703	705,266	1,102	(5,856) 4,739	4.3	-19.5	(5,856) 4,739	100	---	---	Bowbells 1,703; Powers Lake 525; Columbus 465
Burleigh	Bismarck 1,545	1,035,497	1,623	(34,016) 40,714	25.1	19.7	(6,346) 6,011	14.8	(27,620) 34,703	85.2	Bismarck 34,703; Wing 223; Gilton 116
Divide	Crosby 1,992	831,557	1,299	(5,563) 4,565	3.5	-18.0	(5,563) 4,565	100	---	---	Crosby 1,545; Noonan 403; Fortuna 218
Dunn	Manning 1,695	1,275,009	1,992	(6,370) 4,895	2.5	-22.9	(6,370) 4,895	100	---	---	Dunning 1,992; Killdeer 615; Halliday 413
Foremna	Linton 1,409	912,520	1,488	(8,652) 7,200	4.8	-16.9	(8,652) 7,200	100	---	---	Linton 1,845; Strasburg 642; Hazelton 375
Golden Valley	Beach 486	658,960	1,014	(3,100) 2,611	2.6	-15.8	(3,100) 2,611	100	---	---	Beach 1,[illegible]; Sentinel Butte 125; Golva 104
Grant	Carson 1,368	1,063,652	1,662	(6,208) 5,009	3.0	-19.8	(6,208) 5,009	100	---	---	Elgin [illegible]; Carson 466; New Leipzig 354
Hettinger	Mott 696	726,005	1,134	(6,317) 5,075	4.5	-19.7	(6,317) 5,075	100	---	---	Mott 1,368; New England 906; Regent 368
Kidder	Steele 870	885,410	1,352	(5,386) 4,362	3.2	-19.0	(5,386) 4,362	100	---	---	Steele 696; Tuttle 294; Tuttle 216
McHenry	Towner 1,768	1,196,661	1,870	(11,099) 8,977	4.8	-19.1	(11,099) 8,977	100	---	---	Velva 1,[illegible]; Towner 870; Drake 436
McKenzie	Watford City 804	1,750,400	2,735	(7,296) 6,127	2.2	-16.0	(7,296) 6,127	100	---	---	Watford City 1,768; Alexander 208; Arnegard 141
McLean	Washburn 517	1,315,505	2,056	(14,030) 11,251	5.5	-19.8	(14,030) 11,251	100	---	---	Garrison 1,614; Washburn 804; Underwood 281
Mercer	Stanton 11,093	665,606	1,040	(6,805) 6,125	5.9	-9.3	(6,805) 6,125	100	---	---	Beulah 1,344; Stanton 517; Zap 271
Morton	Mandan 1,581	1,228,060	1,919	(20,992) 20,310	10.6	-3.2	(10,667) 9,217	45.4	(10,525) 11,093	54.6	Mandan 11,093; Hebron 1,103; Glen Ullin 1,070
Mountrail	Stanley 619	1,160,029	1,813	(10,072) 8,437	4.7	-16.3	(10,072) 8,437	100	---	---	Stanley 1,581; Palermo 146; White Earth 128
Oliver	Center	460,819	720	(2,610) 2,322	3.2	-11.0	(2,610) 2,322	100	---	---	Center 619

1/ Land Area 1970 census data minus water areas under 40 acres which were obtained from the State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA. General Source: U.S. Census of Population, 1970

COUNTY	COUNTY SEAT & POP.	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]								
Pierce	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Renville	Mohall	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sioux	Amino	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Stark	Dickinson	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ward	Minot	[illegible]	[illegible]	[illegible]	29.0	24.4	[illegible]	24.2	[illegible]	[illegible]	[illegible]
Williams	Williston	1,316,573	2,057	(22,051) 19,301	9.4	-12.5	(10,183) 8,021	41.8	(11,866) 11,280	58.4	Williston 11,280; Tioga 1,667; Ray 776

1/ Land Area 1970 census data minus water areas under 40 acres which were obtained from the State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA. General Source: U.S. Census of Population, 1970

APPENDIX I

Table 2 (Cont'd)

STATE: SOUTH DAKOTA

COUNTY	COUNTY SEAT & POP.	LAND AREA 1/ (640x sq.mi.) Acres	LAND AREA 1/ Sq.Mi.	TOTAL POP.	DENSITY People/ Sq.Mi.	POPULATION % Change 1960-1970	RURAL POP.	% OF TOTAL	URBAN POP.	% OF TOTAL	MAJOR TOWNS & CITIES NAME & POPULATION
Butte	4,236 Belle Fourche	1,433,480	2,240	(8,592) 7,825	3.5	-8.9	(4,505) 3,588	45.9	(4,087) 4,236	54.1	Belle Fourche 4,236; Newell 464; Nisland 157
Corson	563 McIntosh	1,573,238	2,459	(5,708) 4,994	2.3	-13.9	(5,794) 5,436	100	---	---	McLaughlin 863; McIntosh 563; Morristown 144
Dewey	625 Timber Lake	1,502,176	2,347	(5,257) 5,170	2.2	-1.7	(5,257) 5,170	100	---	---	Timber Lake 625; Eagle Butte 530; Isabel 394
Harding	393 Buffalo	1,706,237	2,663	(2,371) 1,895	0.7	-21.8	(2,371) 1,895	100	---	---	Buffalo 393; Camp Creek 150
Meade	4,536 Sturgis	2,210,608	3,455	(14,944) 16,478	4.8	38.0	(7,405) 6,277	37.8	(7,539) 10,341	62.2	Ellsworth 5,800; Sturgis 4,5[illegible]; Faith 576
Perkins	408 Bison	1,823,411	2,849	(5,977) 4,769	1.7	-20.2	(5,977) 4,769	100	---	---	Lemon 1,663; Bison 408
Ziebach	323 Dupree	1,262,586	1,973	(2,495) 2,221	1.1	-11.0	(2,495) 2,221	100	---	---	Dupree 323

1/ Land Area 1970 census data minus water areas under 40 acres which were obtained from the State Conservation Needs Inventory, 1967, Soil Conservation Service, USDA. General Source: U.S. Census of Population, 1970

APPENDIX I

Table 2 (cont'd) STATE: WYOMING

COUNTY	COUNTY SEAT & POP.	LAND AREA 1/ (640sq.mi.) Acres	LAND AREA 1/ Sq.Mi.	TOTAL POP.	DENSITY People/ Sq.Mi.	POPULATION % change 1960-1970	RURAL POP.	% OF TOTAL	URBAN POP.	% OF TOTAL	MAJOR TOWNS & CITIES NAME & POPULATION
Campbell	7,194 Gillette	1,023,281	3,719	(5,861) 10,957	2.7	141.1	(2,281) 5,763	44.5	(3,580) 7,194	55.5	Gillette 7,194
Converse	2,677 Douglas	1,229,129	4,264	(3,861) 5,639	1.6	-6.7	(2,861) 3,261	54.4	(2,822) 2,677	45.1	Douglas 2,677; Glenrock 1,515; Lost Springs 7
Crook	1,056 Sundance	1,413,292	2,565	[illegible]	1.6	+3.1	[illegible]	[illegible]	---	---	Sundance 1,056; Moorcroft 981; [illegible] 118
Johnson	3,396 Buffalo	2,656,363	4,154	[illegible] 6,187	1.5	2.0	[illegible] 2,154	34.3	[illegible] 4,033	65.7	Buffalo 3,396; Kaycee 272
Natrona	39,361 Casper	3,639,307	5,728	[illegible] 71,854	9.6	3.3	[illegible] 11,000	23.[illegible]	[illegible] 60,854	76.4	Casper 39,361; Mills 1,726; [illegible] 835
Niobrara	1,495 Lusk	1,667,995	2,608	[illegible] 2,924	1.1	-22.0	(1,[illegible]) 2,924	100	---	---	Lusk 1,495; Manville 92; [illegible] 21
Sheridan	10,856 Sheridan	1,613,860	2,522	[illegible] 25,452	7.1	-6.0	[illegible] 15,440	39.2	[illegible] 10,[illegible]	60.8	Sheridan 10,856; Dayton 396; [illegible] 208
Weston	3,432 Newcastle	1,531,514	2,393	[illegible] 6,107	2.6	-20.5	(3,564) 2,675	43.6	[illegible] 3,432	56.4	Newcastle 3,432; Upton 937

1/ Land Area 1970 census data minus water areas under 40 acres which were obtained from the State Conservation Needs Inventory, 1967, Soil Conservation Service, USDA. General Source: U.S. Census of Population, 1970

Table 3.--Surface and subsurface (mineral estate) ownership by states and counties

State: Montana

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State 1/	BIA 2/	Private County Municipal	Subtotal Federal 3/	NRL 4/	Nat'l Park System 5/	Dept. of Defense 6/ Corps of Engineers	Dept. of Defense 6/ Military	BSF&W 7/	Bur. of Recl. 8/	ARS 9/	BIA 10/	Nat'l Forest System 11/
Bighorn	Surface Acres	3,235,200	3,195,921	85,201	1,593,400	1,517,320	39,279	27,208	3,965				6,746		1,400	
	%	100	99	3	49	47	1	1	--				--		--	
	Subsurface Acres	3,235,200	2,915,300	85,201	1,792,555	1,037,544	319,900	313,951	3,965				584		1,400	
	%	100	90	3	55	32	10	10	--				--		--	
Carter	Surface Acres	2,120,320	1,518,587	143,199	680	1,374,208	601,733	512,333								89,400
	%	100	72	7	--	65	28	24								4
	Subsurface Acres	2,120,320	1,498,663	143,199	680	1,354,784	621,657	530,566								91,091
	%	100	71	7	--	64	29	25								4
Custer	Surface Acres	2,415,936	2,019,062	138,180		1,880,882	396,874	341,475				168	3	55,228		
	%	100	84	6		78	16	14				--	--	2		
	Subsurface Acres	2,415,936	1,673,006	138,180		1,534,826	742,930	687,531				168	3	55,228		
	%	100	69	6		63	31	29				--	--	2		
Daniels	Surface Acres	922,656	922,610	221,115	38,331	663,166	846	200				646				
	%	100	100	24	4	72	--	--				--				
	Subsurface Acres	923,456	542,376	221,115	34,232	287,029	381,080	381,080				--				
	%	100	59	24	4	31	41	41								

1/ State of Montana (Mineral Estate Not Available, Estimated)
2/ Acres of land owned by the Indians, the title of which is held in trust by the U.S. Government, BIA Data
3/ BLM unpublished data (Mineral Estate)
4/ Bureau of Land Management Data
NRL = National Resource Lands
5/ National Park Service Data
6/ Department of the Army Corps of Engineers Data.
7/ Bureau of Sport Fisheries & Wildlife Data
8/ Bureau of Reclamation Data
9/ Agricultural Research Service Data
10/ Bureau of Indian Affairs Data
11/ Forest Service Data

APPENDIX I

[illegible]

County	Unit	Total Area	Subtotal Nominal State, Cnty & Private	State	BIA	Private County Nominal	[illegible]	[illegible]	Nat'l Park System	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Dawson	Surface Acres	1,523,200	1,[illegible]	82,[illegible]		1,[illegible]	[illegible]	[illegible]					[illegible]			
	%	100	95	6		[illegible]	5	5					--			
	Subsurface Acres	1,523,200	918,640	82,[illegible]		830,[illegible]	[illegible]	[illegible]					[illegible]			
	%	100	60	6		[illegible]	[illegible]	[illegible]					--			
Fallon	Surface Acres	1,045,120	923,214	68,093		855,121	121,976	121,976								
	%	100	88	7		81	12	12								
	Subsurface Acres	1,045,120	963,160	68,093		895,[illegible]	81,960	81,9[illegible]								
	%	100	92	7		85	8	8								
Garfield	Surface Acres	3,079,680	1,983,210	167,061		1,822,[illegible]	1,059,870	51[illegible]		251,112		* 323,[illegible]	[illegible]			
	%	100	64	5		59	30	17		8		11	--			
	Subsurface Acres	3,079,680	1,310,590	167,061		1,143,52[illegible]	1,269,09[illegible]	1,262,[illegible]		182,802		323,910	--			
	%	100	42	5		37	[illegible]	41		6		11				
Golden Valley	Surface Acres	755,200	723,281	18,291		704,9[illegible]	31,919	8,275								23,[illegible]
	%	100	96	2		94	4	1								3
	Subsurface Acres	755,200	709,710	18,291		691,419	45,490	21,846								23,[illegible]
	%	100	94	2		92	6	3								3

* Jointly administered by BLM

APPENDIX I

Table 3 (Cont'd)

State: Montana

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	NRL	Nat'l Park System	Dept. of Defense: Corps of Engineers	Dept. of Defense: Military	BSF&W	Bur. of Recl.	ARS	BIA	Nat'l Forest System
McCone	Surface Acres	1,697,280	1,359,177	94,169	1,790	1,263,218	338,103	202,060		70,022		* 65,983	38			
	%	100	80	6	--	74	20	12		4		4	--			
	Subsurface Acres	1,697,280	754,370	94,169	1,790	658,411	942,910	827,323		49,567		65,983	37			
	%	100	44	6	--	38	56	49		3		4	--			
Musselshell	Surface Acres	1,207,244	1,091,210	75,969		1,015,241	116,534	104,726				11,808				
	%	100	90	6		84	10	9				1				
	Subsurface Acres	1,207,244	977,482	75,969		901,433	230,282	220,365				9,917				
	%	100	81	6		75	19	18				1				
Powder River	Surface Acres	2,110,656	1,506,309	140,860		1,365,449	604,347	257,836					4,565			341,946
	%	100	71	7		64	29	12					--			17
	Subsurface Acres	2,110,656	1,474,666	140,860		1,333,806	635,990	265,061					4,565			366,364
	%	100	70	7		63	30	13					--			17
Prairie	Surface Acres	1,112,896	662,062	71,465		590,597	450,834	450,689					145			
	%	100	59	6		53	41	41					--			
	Subsurface Acres	1,112,896	506,851	71,465		435,386	606,045	605,965					80			
	%	100	45	6		39	55	55					--			

* Jointly administered by BLM

APPENDIX I

Table 1 (Cont'd)

State: Montana

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	[illegible]	Nat'l Park System	Dept. of Defense: Corps of Engineers	Dept. of Defense: Military	[illegible]	Dept. of Int'l	[illegible]	[illegible]	Nat'l Forest System
Richland	Surface Acres	1,345,856	1,291,085	80,971	157	1,209,957	54,771	52,819	47			160	1,735	10		
	%	100	96	6	--	90	4	4	--			--	--	--		
	Subsurface Acres	1,345,856	529,596	80,971	157	448,468	816,260	815,611	47			160	442	--		
	%	100	39	6	--	33	61	61	--			--	--	--		
Roosevelt	Surface Acres	1,535,232	1,479,917	19,944	487,428	972,545	55,315	4,635				1,942	8		48,730	
	%	100	97	1	32	64	3	--				--	--		3	
	Subsurface Acres	1,535,232	1,203,794	19,944	306,768	877,[illegible]	331,438	280,945				1,763	--		48,730	
	%	100	78	1	20	57	22	19				--	--		3	
Rosebud	Surface Acres	3,226,880	2,897,363	177,600	235,829	2,483,934	329,517	233,690								95,827
	%	100	90	6	7	77	10	7								3
	Subsurface Acres	3,226,880	2,539,230	177,600	230,195	2,131,435	687,650	585,794								101,856
	%	100	79	6	7	66	21	18								3
Sheridan	Surface Acres	1,100,736	1,073,484	45,847	51,704	975,933	27,252	300				26,952				
	%	100	98	4	[illegible]	89	2	--				2				
	Subsurface Acres	1,100,736	230,706	45,847	123,964	60,895	870,030	851,015				19,015				
	%	100	21	4	11	6	79	77				2				

APPENDIX I

Table 3 (Cont'd)

State: Montana

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	NRL	Nat'l Park System	Dept. of Defense: Corps of Engineers	Dept. of Defense: Military	BSF&W	Bur. of Recl.	APS	BIA	Nat'l Forest System
Treasure	Surface Acres	638,080	626,188	37,364	16,776	572,048	11,892	11,884					8			
	%	100	93	6	3	89	2	2					--			
	Subsurface Acres	638,080	612,380	37,364	64,000	491,016	25,700	25,700					--			
	%	100	96	6	13	77	4	4					--			
Valley	Surface Acres	3,266,624	1,848,960	211,412	287,116	1,350,432	1,417,664	1,027,336		150,467		* 199,794	2,201		37,866	
	%	100	57	7	9	41	43	31		5		6	--		1	
	Subsurface Acres	3,266,624	1,914,227	211,412	--	1,702,815	1,352,397	1,000,365		114,250		197,915	2,201		37,866	
	%	100	59	7	--	52	41	31		3		6	--		1	
Wibaux	Surface Acres	570,240	544,358	32,670		511,688	25,882	25,882								
	%	100	95	6		89	5	5								
	Subsurface Acres	570,240	353,360	32,670		320,690	216,880	216,880								
	%	100	62	6		56	38	38								
Yellow-stone	Surface Acres	1,706,112	1,619,262	79,127	149,812	1,390,323	86,850	85,792					1,058			
	%	100	95	5	9	81	5	5					--			
	Subsurface Acres	1,706,112	1,578,582	79,127	176,000	1,323,455	127,530	126,521					1,069			
	%	100	93	5	10	78	7	7					--			

* Jointly administered by BLM

APPENDIX I

Table 3 (Cont'd)

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State: Montana

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BLM	Private County Municipal	Subtotal Federal	NRA	Nat'l Park System	Dept. of Defense: Corps of Engineers	Dept. of Defense: Military	BSF&W	Bur. of Recl.	[illegible]	BIA	Nat'l Forest System
All Counties	Surface Acres	34,616,449	28,745,672	[illegible]	862,043	23,[illegible]	5,870,775	4,050,982	4,012	471,601		* 631,363	18,766	55,238	87,994	550,812
	%	100	83.0	5.8	8.2	69.0	17.0	11.7	--	1.4		1.8	--	.2	.3	1.6
	Subsurface Acres	34,616,449	23,206,669	1,996,245	2,750,341	18,440,08[illegible]	1,409,779	2,703,474	4,012	346,619		618,831	10,667	55,228	87,994	582,952
	%	100	67.0	5.8	7.9	53.1	33.0	28.0	--	1.0		1.8	--	.2	.3	1.7

* 589,687 acres jointly administered by BLM

APPENDIX I

Table 3 (Cont'd)

State: North Dakota

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State 1/	BIA 2/	Private County Municipal	Subtotal Federal 3/	NRL 4/	Nat'l Park System 5/	Dept. of Defense: Corps of Engineers 6/	Dept. of Defense: Military 6/	BSF&W 7/	Bur. of Recl. 8/	ARS 9/	BIA 10/	Nat'l Forest System 11/
Adams	Surface Acres	633,600	632,520	18,716	91	614,713	80	80								
	%	100	100	3	--	97	--	--								
	Subsurface Acres	633,600	524,700	18,716	0	505,984	108,900	108,900								
	%	100	83	3		80	17	17								
Billings	Surface Acres	728,960	392,284	31,561		360,723	336,676	660	46,010							289,986
	%	100	54	4		50	46	--	6							40
	Subsurface Acres	728,960	358,140	31,561		326,579	370,820	78,586	45,930							246,304
	%	100	49	4		45	51	11	6							34
Bottineau	Surface Acres	1,092,480	1,069,032	3,874		1,065,158	23,448	--			25	23,423				
	%	100	98	1		97	2				--	2				
	Subsurface Acres	1,092,480	1,06[illegible],487	3,874		1,061,613	26,993	5,560			--	21,433				
	%	100	98	1		97	2	--				2				
Bowman	Surface Acres	748,800	712,565	29,433		683,132	36,235	32,800		3,427						
	%	100	95	4		91	5	4		1						
	Subsurface Acres	748,800	516,340	29,433		486,907	232,460	232,453		7						
	%	100	69	4		65	31	31		--						

1/ State Data (Mineral Estate Not Available, Estimated)
2/ Acres of land owned by the Indians, the title of which is held in trust by the U.S. Government. (BIA Data).
3/ BLM unpublished data (Mineral Estate)
4/ Bureau of Land Management
NRL = National Resource Lands
5/ National Park Service Data
6/ Dept. of the Army, Corps of Engineers, Data
7/ Bureau of Sport Fisheries & Wildlife Data
8/ Bureau of Reclamation Data
9/ Agricultural Research Service Data
10/ Bureau of Indian Affairs Data
11/ Forest Service Data

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Table 3 (Cont'd)

State: North Dakota

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	NRL	Nat'l Park System	Dept. of Defense: Corps of Engineers	Dept. of Defense: Military	BSFAW	Bur. of Recl.	[illegible]	BIA	Nat'l Forest System
Burke	Surface Acres	722,560	689,397	17,215	320	671,862	33,163	--			25	33,140				
	%	100	95	2	--	93	5				--	5				
	Subsurface Acres	722,560	624,970	17,215	--	617,775	87,570	58,005			--	29,565				
	%	100	88	2		86	12	8				4				
Burleigh	Surface Acres	1,072,000	1,047,394	31,628		1,015,765	24,606	737		7,394	10	13,502	2,965			
	%	100	98	3		95	2	--		1	--	1	--			
	Subsurface Acres	1,072,000	1,031,040	31,628		999,412	40,960	29,142		--	--	11,818	--			
	%	100	96	3		93	4	3				1	--			
Divide	Surface Acres	836,480	825,450	22,399	639	802,412	11,030	1,666			130	9,234				
	%	100	99	3	--	96	1	--			--	1				
	Subsurface Acres	836,480	546,520	22,399	639	523,482	289,960	288,874				1,086				
	%	100	65	3	--	62	35	35				--				
Dunn	Surface Acres	1,331,840	1,251,265	30,319	200,012	1,020,934	80,575	15,989		61,334		3,193	16		43	--
	%	100	94	2	15	77	6	1		5		--	--		--	
	Subsurface Acres	1,331,840	903,000	30,319	255,200	617,481	428,840	423,113		1,183		1,947	--		43	2,554
	%	100	68	2	19	47	32	32		--		--			--	--

APPENDIX I

Table 3 (Cont'd)

State: North Dakota

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	BLM	Nat'l Park System	Dept. of Defense: Corps of Engineers	Dept. of Defense: Military	DSF&W	Bur. of Recl.	ARS	BIA	Nat'l Forest System
Emmons	Surface Acres	997,760	962,687	17,607		945,080	35,073	941		31,377		2,743	12			
	%	100	96	2		94	4	--		4		--	--			
	Subsurface Acres	997,760	985,640	17,607		968,033	12,120	10,250		--		1,870	--			
	%	100	99	2		97	1	1		--		--	--			
Golden Valley	Surface Acres	648,960	550,255	29,048		521,207	98,705	2,358					5			96,342
	%	100	85	4		81	15	--					--			15
	Subsurface Acres	648,960	345,020	29,048		315,972	303,940	212,241					--			91,699
	%	100	53	4		49	47	33					--			14
Grant	Surface Acres	1,070,080	1,058,233	36,200		1,022,033	11,847	589					10,778			480
	%	100	99	3		96	1	--					1			--
	Subsurface Acres	1,070,080	969,220	36,200		933,020	100,860	90,095					10,764			--
	%	100	91	3		88	9	8					1			--
Hettinger	Surface Acres	726,400	726,400	11,048		715,352	--	--								
	%	100	100	2		98	--	--								
	Subsurface Acres	726,400	486,160	11,048		475,112	240,240	240,240								
	%	100	67	2		65	33	33								

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Table 3 (Cont'd)

State: North Dakota

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	NRL	Nat'l Park System	Dept. of Defense: Corps of Engineers	Dept. of Defense: Military	BSF&W	Bur. of Recl.	ARS	BIA	Nat'l Forest System
Kidder	Surface Acres	915,200	902,970	32,205		870,7[illegible]	12,230	1,520				10,72[illegible]	6			
	%	100	99	4		95	1	--				1	--			
	Subsurface Acres	915,200	906,193	32,205		873,9[illegible]	9,007	1,520				7,487				
	%	100	99	4		95	1	--				1				
McHenry	Surface Acres	1,218,560	1,173,779	22,790		1,150,99[illegible]	44,781	3,233			37	40,717	3			796
	%	100	96	2		94	4	--			--	4	--			--
	Subsurface Acres	1,218,560	1,152,698	22,790		1,129,90[illegible]	65,862	29,340			--	36,002	--			520
	%	100	95	2		93	5	2			--	3	--			--
McKenzie	Surface Acres	1,818,880	1,224,328	66,185	80,465	1,077,67[illegible]	594,552	1,506	23,506	66,224			204		65	503,047
	%	100	67	4	4	59	33	--	1	4			--		--	28
	Subsurface Acres	1,818,880	651,300	66,185	94,725	490,3[illegible]	1,167,580	677,538	23,506	--			200		65	466,271
	%	100	36	4	5	27	64	37	1	--			--		--	26
McLean	Surface Acres	1,489,280	1,315,424	25,587	91,563	1,198,274	173,856	599		159,191	63	5,261	8,692		50	
	%	100	88	2	6	80	12	--		11	--	--	1		--	
	Subsurface Acres	1,489,280	1,441,960	25,587	194,350	1,222,023	47,320	34,159		11,741	--	1,327	43		50	
	%	100	97	2	13	82	3	2		1	--	--	--		--	

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Table 3 (Cont'd)

State: North Dakota

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	NWL	Nat'l Park System	Dept. of Defense: Corps of Engineers	Dept. of Defense: Military	BSFWS	Fur. of Recl.	NPS	BIA	Nat'l Forest System
Mercer	Surface Acres	710,400	658,417	15,624	27,012	615,771	51,983	459		51,519			5		--	
	%	100	93	2	4	87	7	--		7			--		--	
	Subsurface Acres	710,400	548,300	15,624	47,225	485,441	162,100	161,700		400			--			
	%	100	77	2	7	68	23	23		--			--			
Morton	Surface Acres	1,244,160	1,230,390	19,960		1,210,430	13,770	252		12,397			2	1,119		
	%	100	99	2		97	1	--		1			--	--		
	Subsurface Acres	1,244,160	1,171,920	19,960		1,151,960	72,240	71,121		--			--	1,119		
	%	100	94	2		92	6	6		--			--	--		
Mountrail	Surface Acres	1,231,360	1,155,244	34,460	21,346	1,099,438	76,116	1,303		65,025	80	9,702	--		6	
	%	100	94	3	2	89	6	--		5	--	1	--		--	
	Subsurface Acres	1,231,360	933,740	34,460	107,475	791,805	297,620	289,915		4,757		2,942			6	
	%	100	76	3	9	64	24	24		--		--			--	
Oliver	Surface Acres	466,560	464,274	10,563		455,711	286	274					12			
	%	100	100	2		98	--	--					--			
	Subsurface Acres	466,560	372,120	10,563		361,557	94,440	94,440					--			
	%	100	80	2		78	20	20					--			

Table 3 (Cont'd)

State: North Dakota

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	NRL	Nat'l Park System	Dept. of Defense: Corps of Engineers	Dept. of Defense: Military	DSFRS	Bur. of Recl.	ARS	SIA	Nat'l Forest System
Pierce	Surface Acres	693,120	685,914	14,891		671,023	7,206	136				7,061	10			
	%	100	99	2		97	1	--				1	--			
	Subsurface Acres	693,120	687,160	14,891		672,269	5,960	2,270				3,690	--			
	%	100	99	2		97	1	--				1	--			
Renville	Surface Acres	576,640	551,270	2,071		549,199	25,370	78			30	25,262				
	%	100	96	--		96	4	--			--	4				
	Subsurface Acres	576,640	551,704	2,071		549,633	24,936	78			--	24,858				
	%	100	96	--		96	4	--			--	4				
Sheridan	Surface Acres	643,200	630,435	33,821		596,614	12,765	328			2	6,566	5,819			
	%	100	98	5		93	2	--			--	1	1			
	Subsurface Acres	643,200	587,800	33,821		553,979	55,400	53,567			--	1,651	182			
	%	100	91	5		86	9	9			--	--	--			
Sioux	Surface Acres	725,120	707,050	24,898	293,951	388,201	18,070	--		7,985		--			3,848	6,237
	%	100	98	3	41	54	2	--		1		--			--	1
	Subsurface Acres	725,120	708,515	24,898	308,100	375,517	16,605	7,480		--					3,840	5,277
	%	100	98	3	43	52	2	1		--					--	1

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Table 3 (Cont'd)

State: North Dakota

County	Unit	Total Area	Subtotal Non Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	NPL	Nat'l Park System	Dept. of Defense: Corps of Engineers	Dept. of Defense: Military	DSTAC	Bur. of Rec'l.	ARS	FSA	Nat'l Forest System
Slope	Surface Acres	784,640	645,239	23,622		621,617	139,401	--				1,044				138,357
	%	100	82	3		79	18	--				--				18
	Subsurface Acres	784,640	411,220	23,622		387,268	373,250	246,346				484				126,420
	%	100	52	3		49	48	32				--				16
Stark	Surface Acres	844,160	841,899	6,934		834,965	2,261	--					2,261			
	%	100	100	1		99	--	--					--			
	Subsurface Acres	844,160	675,480	6,934		668,546	168,680	168,680					--			
	%	100	80	1		79	20	20					--			
Ward	Surface Acres	1,312,120	1,294,504	12,449		1,282,055	22,616	266			4,970	17,380				
	%	100	98	1		97	2	--			--	2				
	Subsurface Acres	1,312,120	1,201,380	12,449		1,189,431	115,240	101,634				13,606				
	%	100	91	1		90	9	8				1				
Williams	Surface Acres	1,368,320	1,311,645	42,031	8,076	1,261,538	56,675	1,303	195	48,165		6,974	38			
	%	100	96	3	1	92	4	--	--	3		1	--			
	Subsurface Acres	1,368,320	881,540	42,031	8,076	831,433	486,780	485,734	195			825	26			
	%	100	64	3	1	60	36	36	--			--	--			

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Table 3 (Cont'd)

State: North Dakota

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	NRL	Nat'l Park System	Dept. of Defense: Corps of Engineers	Dept. of Defense: Military	DSFNW	Bur. of Recl.	ARS	BIA	Nat'l Forest System
All Counties	Surface Acres	26,656,640	24,713,264	667,149	723,475	23,322,640	1,943,726	67,145	69,711	514,078	5,370	215,999	30,837	1,119	4,012	1,035,245
	%	100	92.7	2.5	2.7	87.5	7.3	.3	.3	1.9	--	.8	.1	--	--	3.9
	Subsurface Acres	26,656,640	21,249,957	667,149	1,015,790	19,567,018	5,406,683	4,202,982	69,631	18,088	--	160,591	11,215	1,119	4,012	939,045
	%	100	79.7	2.5	3.8	72.4	20.3	15.8	.3	--	--	.6	--	--	--	3.6

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Table 1 (cont'd)

State: South Dakota

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	1/ State (1a/)	2/ BIA	Private County Municipal	3/ Subtotal Federal	4/ NRL	5/ Nat'l Park System	6/ Dept. of Defense: Corps of Engineers	6/ Dept. of Defense: Military	7/ BSF&W	8/ Bur. of Recl.	9/ ARS	10/ BIA	11/ Nat'l Forest System
Butte	Surface Acres	1,450,240	1,287,392	100,320		1,187,07	162,848	145,591			756		15,841	360		
	%	100	89	7		82	11	10			--		1	--		
	Subsurface Acres	1,450,240	913,180	135,559		777,621	537,060	520,859					15,841	360		
	%	100	63	9		54	37	36					1	--		
Corson	Surface Acres	1,623,040	1,558,051	41,555	539,669	978,827	64,569			27,477					6,407	31,105
	%	100	96	3	33	60	4			2					--	2
	Subsurface Acres	1,623,040	1,591,629	140,015	645,525	806,09	31,411								6,407	25,004
	%	100	98	9	40	49	2								--	2
Dewey	Surface Acres	1,559,680	1,467,740	16,382	845,360	605,998	91,940			91,940						
	%	100	94	1	54	39	6			6						
	Subsurface Acres	1,559,680	1,556,376		834,350	722,026	3,304									3,304
	%	100	100		54	46	--									--
Harding	Surface Acres	1,717,120	1,613,739	329,992		1,283,747	103,381	29,850		12						73,489
	%	100	94	19		75	6	2								4
	Subsurface Acres	1,717,120	1,319,550	473,239		846,311	397,570	323,230								74,331
	%	100	77	28		49	23	19								4

1/ State Planning Bureau (Surface Acres)
1a/ South Dakota's Mineral Acres and How We Lease Them for Oil & Gas, State of South Dakota, Department of School & Public Lands.
2/ Acres of land owned by the Indians, the title of which is held in trust by the U.S. Government (BIA Data).
3/ BLM unpublished data (Mineral Estate)
4/ Bureau of Land Management Data
5/ National Park Service Data
6/ Dept. of the Army, Corps of Engineers, Data.
7/ Bureau of Sport Fisheries & Wildlife Data
8/ Bureau of Reclamation Data
9/ Agricultural Research Service Data
10/ Bureau of Indian Affairs Data
11/ Forest Service Data

Footnote: NRL = National Resource Lands administered by the Bureau of Land Management

Table 3 (Cont'd)

State: South Dakota

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	BLM	Nat'l Park System	Dept. of Defense Corps of Engineers	Dept. of Defense Military	BSFW	Bur. of Recl.	ARS	BIA	Nat'l Forest System
Meade	Surface Acres	2,318,240	2,141,35[illegible]	92,206	160	2,049,3[illegible]	75,08[illegible]	35,407			5,065		155			35,239
	%	100	97	4	--	93	3	2			--		--			1
	Subsurface Acres	2,318,240	1,951,71[illegible]	277,357		1,674,3[illegible]	266,52[illegible]	221,162			--		12[illegible]			35,239
	%	100	86	13		75	12	11			--		--			1
Perkins	Surface Acres	1,834,260	1,487,566	83,515	640	1,403,711	146,374	9,227			2		13,158			123,987
	%	100	92	5	--	87	8				--		1			7
	Subsurface Acres	1,834,260	1,661,725	339,322	--	1,322,403	172,515	45,865					3,454			123,196
	%	100	90	18	--	72	10	3					--			7
Ziebach	Surface Acres	1,269,120	1,266,717	26,276	556,341	684,1[illegible]	2,40[illegible]	--		2,395			13			
	%	100	100	2	44	54	--	--		--			--			
	Subsurface Acres	1,269,120	1,269,120	139,520	619,750	509,8[illegible]	--	--		--			--			
	%	100	100	11	49	40	--	--		--			--			
All Counties	Surface Acres	11,671,650	11,023,855	620,296	1,942,170	8,391,3[illegible]	647,82[illegible]	220,605		121,824	5,843		29,166	360	6,407	263,820
	%	100	94.4	5.9	16.6	71.9	5.6	1.9		1.0	.1		.2	--	.1	2.3
	Subsurface Acres	11,671,650	10,263,791	1,505,015	2,099,625	6,658,65[illegible]	1,408,38[illegible]	1,121,125		--	--		19,423	360	6,407	261,074
	%	100	87.9	12.9	18.0	57.0	12.1	9.6		--	--		.2	--	.1	2.2

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Table 3 (Cont'd)

State: Wyoming

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State 1/	BIA 2/	Private County Municipal	Subtotal Federal 3/	NRL 4/	Nat'l Park System 5/	Dept. of Defense 6/ Corps of Engineers	Dept. of Defense 6/ Military	BSF&W 7/	Bur. of Recl. 8/	ARS 9/	BIA 10/	Nat'l Forest System 11/
Campbell	Surface Acres	3,043,840	2,659,485	199,124		2,460,361	384,355	223,318					3,032			158,005
	%	100	87	6		81	13	8					--			5
	Subsurface Acres	3,043,840	1,619,634	216,993		1,402,641	1,424,206	1,263,169					3,032			158,005
	%	100	53	7		46	47	42					--			5
Converse	Surface Acres	2,741,120	2,359,145	259,259		2,090,886	390,975	128,866					1,488			260,621
	%	100	86	10		76	14	5					--			9
	Subsurface Acres	2,741,120	1,687,439	285,352		1,402,087	1,053,681	793,060					--			260,621
	%	100	62	11		51	38	29					--			9
Crook	Surface Acres	1,854,080	1,562,022	124,022		1,442,139	286,938	103,025	1,347		21		16,134			166,441
	%	100	85	7		78	15	5	--		--		1			9
	Subsurface Acres	1,854,080	1,232,417	153,716		1,078,701	616,663	447,600	1,347		--		1,255			166,441
	%	100	67	9		58	33	24	--		--		--			9
Johnson	Surface Acres	2,674,560	1,892,276	221,150		1,588,126	865,234	528,409								326,875
	%	100	68	8		60	32	20								12
	Subsurface Acres	2,674,560	1,538,285	206,873		1,281,412	1,086,275	759,400								326,875
	%	100	59	7		52	41	29								12

1/ State of Wyoming Data
2/ Acres of land owned by the Indians, the title of which is held in trust by the U.S. Government (BIA Data).
3/ BLM unpublished data (Mineral Estate).
4/ Bureau of Land Management
NRL = National Resource Lands
5/ National Park Service Data
6/ Dept. of the Army, Corps of Engineers, Data.
7/ Bureau of Sport Fisheries & Wildlife Data
8/ Bureau of Reclamation Data
9/ Agricultural Research Service Data
10/ Bureau of Indian Affairs Data
11/ Forest Service Data (Mineral Estate Estimated)

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Table 3 (Cont'd)

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State: Wyoming

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BIA	Private County Municipal	Subtotal Federal	NRL	Nat'l Park System	Dept. of Defense Corps of Engineers	Dept. of Defense Military	BSF&W	Bur. of Recl.	APS	BIA	Nat'l Forest System
Natrona	Surface Acres	3,436,160	2,028,714	397,758		1,630,956	1,407,446	1,373,680				1,240	26,917			5,615
	%	100	59	12		47	41	40				--	1			--
	Subsurface Acres	3,436,160	1,611,475	267,743		1,343,733	1,824,685	1,797,762				1,240	20,068			5,615
	%	100	47	8		39	53	52				--	1			--
Niobrara	Surface Acres	1,672,960	1,512,405	163,878		1,348,577	160,555	159,704					11			840
	%	100	90	9		81	10	10					--			--
	Subsurface Acres	1,672,960	1,035,690	168,962		866,728	637,270	636,430					--			840
	%	100	62	10		52	38	38					--			--
Sheridan	Surface Acres	1,620,480	1,174,425	123,911		1,050,514	446,055	50,669					825			394,562
	%	100	72	8		65	27	3			--		--			24
	Subsurface Acres	1,620,480	895,274	194,595		700,679	725,206	329,819					825			394,562
	%	100	55	12		43	45	21					--			24
Weston	Surface Acres	1,541,120	1,228,692	113,005		1,115,687	317,428	78,684								233,744
	%	100	80	7		73	20	5								15
	Subsurface Acres	1,541,120	997,338	124,848		872,490	543,782	310,038								233,744
	%	100	65	8		57	35	20								15

APPENDIX I

Table 3 (Cont'd)

State: Wyoming

County	Unit	Total Area	Subtotal Non-Fed. State, Cnty & Private	State	BLM	Private County Municipal	Subtotal Federal	NRL	Nat'l Park System	Dept. of Defense		DSF&W	Bur. of Recl.	ARS	BIA	Nat'l Forest System
										Corps of Engineers	Military					
All Counties	Surface Acres	18,584,320	14,330,234	1,602,935		12,727,296	4,254,086	2,656,354	1,347		21	1,240	48,401			1,546,723
	%	100	77.1	8.6		68.5	22.9	14.3	--		--	--	.3			8.3
	Subsurface Acres	18,584,320	10,672,552	1,624,085		9,048,470	7,911,768	6,337,278	1,347		--	1,240	25,180			1,546,723
	%	100	57.4	8.7		48.7	42.6	34.1	--		--	--	.2			8.3

Northern Great Plains Resources Program
Surface Resources Work Group

[illegible]

[illegible]

Table 4.--[illegible]

State: Montana

County & Owner Group	Commercial Forest Land	Non-com. Forest Land	Total Forest Land	Nonforest Land	Total Water Area 2/	Gross Area	Net Volume of Growing Stock on CFL Thousand Cubic Feet: Softwood	Hardwood	Total	Net Volume of Sawtimber on CFL Thousand Board Feet 1/: Softwood	Hardwood	Total
Bighorn												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	120,362	95,630	215,992	--	--	--	171,351	10,596	181,947	536,820	48,371	585,191
Private	78,281	41,601	119,882	--	--	--	99,911	5,799	105,710	316,679	25,583	342,262
Total Non-NFS	198,643	137,231	335,874	2,878,146	--	--	271,262	16,395	287,657	853,499	73,954	927,453
Total all owners	198,643	137,231	335,874	2,878,146	21,180	3,235,200	271,262	16,395	287,657	853,499	73,954	927,453
Carter												
National For.	42,394	1,922	44,316	--	--	--	19,722	277	19,999	68,147	441	68,588
Other Public	1,057	1,522	2,579	--	--	--	1,545	107	1,652	4,452	487	4,939
Private	18,709	6,460	25,169	--	--	--	24,196	1,481	25,677	72,754	6,409	79,163
Total Non-NFS	19,766	7,982	27,748	1,997,195	--	--	25,741	1,588	27,329	77,206	6,896	84,102
Total all owners	62,160	9,904	72,064	2,042,319	5,937	2,120,320	45,463	1,865	47,328	145,353	7,337	152,690
Custer												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	7,214	2,044	9,258	--	--	--	7,554	347	7,901	22,721	1,263	23,984
Private	41,735	15,745	57,480	--	--	--	42,403	1,871	44,274	124,803	7,478	132,281
Total Non-NFS	48,949	17,789	66,738	2,328,210	--	--	49,957	2,218	52,175	147,524	8,741	156,265
Total all owners	48,949	17,789	66,738	2,328,210	20,988	2,415,936	49,957	2,218	52,175	147,524	8,741	156,265
Daniels												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	--	--	--	--	--	--	--	--	--	--	--	--
Total Non-NFS	--	--	--	921,482	--	--	--	--	--	--	--	--
Total all owners	--	--	--	921,482	1,974	923,456	--	--	--	--	--	--
Dawson												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	3,138	1,233	4,371	--	--	--	4,615	181	4,796	15,589	859	16,448
Private	5,581	3,797	9,378	--	--	--	11,802	970	12,772	42,538	4,380	46,918
Total Non-NFS	8,719	5,030	13,749	1,501,373	--	--	16,417	1,151	17,568	58,127	5,239	63,366
Total all owners	8,719	5,030	13,749	1,501,373	8,078	1,523,200	16,417	1,151	17,568	58,127	5,239	63,366
Fallon												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	--	--	--	--	--	--	--	--	--	--	--	--
Total Non-NFS	--	--	--	1,043,452	--	--	--	--	--	--	--	--
Total all owners	--	--	--	1,043,452	1,668	1,045,120	--	--	--	--	--	--

1/ International ¼ - inch rule.
2/ Gross area is U. S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory 1970, Soil Conservation Service, USDA.
SOURCE: USDA, Forest Service.

APPENDIX 7

Table 8 (Cont'd)

State: Montana

County & Owner Group	Commercial Forest Land	Non-com. Forest Land	Total Forest Land	Nonforest Land	Total 2/ Water Area	Gross Area	Net Volume of Growing Stock on CFL Thousand Cubic Feet			Net Volume of Sawtimber on CFL Thousand Board Feet 1/		
							Softwood	Hardwood	Total	Softwood	Hardwood	Total
Garfield												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	31,875	31,882	63,757	--	--	--	22,122	172	22,294	63,384	551	63,935
Private	18,531	17,152	35,683	--	--	--	14,942	354	15,296	43,121	1,422	44,543
Total Non-NFS	50,406	49,034	99,440	2,748,632	--	--	37,064	526	37,590	106,505	1,973	108,478
Total all owners	50,406	49,034	99,440	2,748,632	231,608	3,079,680	37,064	526	37,590	106,505	1,973	108,478
Golden Valley												
National For.	10,345	9,550	19,895	3,749	--	--	13,297	--	13,297	39,682	--	39,682
Other Public	6,530	3,453	9,983	--	--	--	7,875	313	8,188	25,036	1,417	26,453
Private	14,683	5,923	20,606	--	--	--	15,013	681	15,694	43,185	3,020	46,205
Total Non-NFS	21,213	9,376	30,589	697,962	--	--	22,888	994	23,882	68,221	4,437	72,658
Total all owners	31,558	18,926	50,484	701,711	3,005	755,200	36,185	994	37,179	107,903	4,437	112,340
McCone												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	2,114	316	2,430	--	--	--	3,734	301	4,035	10,271	1,517	11,788
Private	3,059	1,249	4,308	--	--	--	4,360	302	4,662	12,033	1,521	13,554
Total Non-NFS	5,173	1,565	6,738	1,657,020	--	--	8,094	603	8,697	22,304	3,038	25,342
Total all owners	5,173	1,565	6,738	1,657,020	33,522	1,697,280	8,094	603	8,697	22,304	3,038	25,342
Musselshell												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	16,769	8,559	25,328	--	--	--	17,409	804	18,213	51,036	3,302	54,338
Private	158,080	75,105	233,185	--	--	--	163,973	7,497	171,470	486,366	30,945	517,311
Total Non-NFS	174,849	83,664	258,513	947,682	--	--	181,382	8,301	189,683	537,402	34,247	571,649
Total all owners	174,849	83,664	258,513	947,682	1,549	1,207,744	181,382	8,301	189,683	537,402	34,247	571,649
Powder River												
National For.	162,374	6,753	169,127	172,819	--	--	14,047	180	14,227	46,293	284	46,577
Other Public	16,651	8,860	25,511	--	--	--	16,376	675	17,051	48,896	2,463	51,359
Private	60,485	24,045	84,530	--	--	--	60,013	2,522	62,535	177,478	9,746	187,224
Total Non-NFS	77,136	32,905	110,041	1,650,541	--	--	76,389	3,197	79,586	226,374	12,209	238,583
Total all owners	239,510	39,658	279,168	1,823,360	8,128	2,110,656	90,436	3,377	93,813	272,667	12,493	285,160
Prairie												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	--	--	--	--	--	--	--	--	--	--	--	--
Total Non-NFS	--	--	--	1,106,364	--	--	--	--	--	--	--	--
Total all owners	--	--		1,106,364	6,532	1,112,896	--	--	--	--	--	--

1/ International ¼ - inch rule.

2/ Gross area is U. S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory 1970, Soil Conservation Service, USDA.

SOURCE: USDA, Forest Service.

[illegible]

[illegible]

County & Owner Class	Commercial Forest Land	National Forest Land	Total Forest Land	Nonforest Land	Total Water 2/ Area	Gross Area	Net Volume of Growing Stock on GFL Thousand Cubic Feet			Net Volume of Sawtimber on GFL Thousand Board Feet 1/		
							Softwood	Hardwood	Total	Softwood	Hardwood	Total
Highland												
National For.	--	--	--	--	--	--	--	--	--	--	--	-
Other Public	1,468	455	1,923	--	--	--	1,192	29	1,221	3,522	92	3,614
Private	7,783	5,655	13,438	--	--	--	14,622	1,131	15,753	52,836	5,139	57,975
Total Non-NFS	9,251	6,110	15,361	1,311,055	--	--	15,814	1,160	16,974	56,358	5,231	61,589
Total all owners	9,251	6,110	15,361	1,311,055	19,440	1,345,856	15,814	1,160	16,974	56,358	5,231	61,589
Roosevelt												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	5,028	1,432	6,470	--	--	--	9,187	719	9,906	30,629	3,319	33,948
Private	3,074	166	3,230	--	--	--	7,373	498	7,871	27,977	2,333	30,310
Total Non-NFS	8,102	1,598	9,700	1,513,996	--	--	16,560	1,217	17,777	58,606	5,652	64,258
Total all owners	8,102	1,598	9,700	1,513,996	11,536	1,535,232	16,560	1,217	17,777	58,606	5,652	64,258
Rockland												
National For.	42,319	1,984	44,303	51,524	--	--	54,892	699	55,591	180,864	1,110	181,974
Other Public	66,735	33,901	100,636	--	--	--	73,062	3,665	76,727	215,962	15,366	231,328
Private	83,094	52,236	135,330	--	--	--	75,475	2,598	78,073	225,841	10,640	236,481
Total Non-NFS	149,829	86,137	235,966	2,888,527	--	--	148,537	6,263	154,800	441,803	26,006	467,809
Total all owners	192,148	88,121	280,269	2,940,051	6,560	3,226,880	203,419	6,962	210,381	622,667	27,116	649,783
Shoshone												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	--	645	645	--	--	--	--	--	--	--	--	--
Total Non-NFS	--	645	645	1,080,731	--	--	--	--	--	--	--	--
Total all owners	--	645	645	1,080,731	19,360	1,100,736	--	--	--	--	--	--
Teton												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	--	1,278	1,278	--	--	--	--	--	--	--	--	--
Private	26,259	11,812	38,071	--	--	--	25,140	988	26,128	75,621	4,585	80,206
Total Non-NFS	26,259	13,090	39,349	589,994	--	--	25,140	988	26,128	75,621	4,585	80,206
Total all owners	26,259	13,090	39,349	589,994	8,737	638,080	25,140	988	26,128	75,621	4,585	80,206
Valley												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	8,845	6,786	15,631	--	--	--	10,805	630	11,435	31,438	2,746	34,184
Private	10,694	6,172	16,866	--	--	--	15,507	1,062	16,569	46,414	4,930	51,344
Total Non-NFS	19,539	12,958	32,497	3,146,103	--	--	26,312	1,692	28,004	77,852	7,676	85,528
Total all owners	19,539	12,958	32,497	3,146,103	88,024	3,266,624	26,312	1,692	28,004	77,852	7,676	85,528

1/ International ¼ - inch rule.

2/ Gross area is U. S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory 1970, Soil Conservation Service, USDA.

SOURCE: USDA, Forest Service.

State: Montana

County & Owner Group	Commercial Forest Land	Non-com. Forest Land	Total Forest Land	Nonforest Land	Total Water 2/ Area	Gross Area	Net Volume of Growing Stock on CFL Thousand Cubic Feet			Net Volume of Sawtimber on CFL Thousand Board Feet 1/		
							Softwood	Hardwood	Total	Softwood	Hardwood	Total
Wibaux												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	--	--	--	--	--	--	--	--	--	--	--	--
Total Non-NFS	--	--	--	568,376	--	--	--	--	--	--	--	--
Total all owners	--	--	--	568,376	1,864	570,240	--	--	--	--	--	--
Yellowstone												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	7,357	8,885	16,242	--	--	--	7,721	352	8,073	24,583	1,478	26,061
Private	41,575	30,832	72,407	--	--	--	38,017	1,334	39,351	113,884	5,677	119,561
Total Non-NFS	48,932	39,717	88,649	1,601,539	--	--	45,738	1,686	47,424	138,467	7,155	145,622
Total all owners	48,932	39,717	88,649	1,601,539	15,924	1,706,112	45,738	1,686	47,424	138,467	7,155	145,622

1/ International ¼ - inch rule.
2/ Gross area is U. S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory 1970, Soil Conservation Service, USDA.
SOURCE: USDA, Forest Service.

APPENDIX I

Table 1 (cont'd)

State: North Dakota

County & Owner Group	Commercial Forest Land	Non-com. Forest Land 3/	Total Forest Land	Nonforest Land	Total 2/ Water Area	Gross Area	Net Volume of Growing Stock on CFL Thousand Cubic Feet			Net Volume of Sawtimber on CFL Thousand Board Feet 1/		
							Softwood	Hardwood	Total	Softwood	Hardwood	Total
Adams												
Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	200	--	--	--	--	--	--	100	100	--	204	204
Total	200	--	200	632,738	662	633,600	--	100	100	--	204	204
Billings												
Public	3,300	--	--	--	--	--	--	2,216	2,216	--	4,520	4,520
Private	7,300	--	--	--	--	--	--	4,978	4,978	--	10,154	10,154
Total	10,600	2,000	12,600	714,744	1,616	728,960		7,194	7,194		14,674	14,674
Bottineau												
Public	12,500	--	--	--	--	--	--	8,493	8,493	--	17,325	17,325
Private	28,000	--	--	--	--	--	--	19,082	19,082	--	38,925	38,925
Total	40,500	1,300	41,800	1,025,758	24,922	1,092,480	--	27,575	27,575	--	56,250	56,250
Bowman												
Public	200	--	--	--	--	--	--	123	123	--	251	251
Private	300	--	--	--	--	--	--	277	277	--	564	564
Total	500	--	500	748,086	214	748,800	--	400	400	--	815	815
Burke												
Public	100	--	--	--	--	--	--	92	92	--	188	188
Private	300	--	--	--	--	--	--	208	208	--	423	423
Total	400	--	400	704,866	17,294	722,560	--	300	300	--	611	611
Burleigh												
Public	1,700	--	--	--	--	--	--	1,169	1,169	--	2,385	2,385
Private	3,800	--	--	--	--	--	--	2,628	2,628	--	5,360	5,360
Total	5,500	200	5,700	1,032,797	33,503	1,072,000	--	3,797	3,797	--	7,745	7,745
Divide												
Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	--	--	--	--	--	--	--	--	--	--	--	--
Total	--	--	--	831,557	4,923	836,480	--	--	--	--	--	--
Dunn												
Public	10,300	--	--	--	--	--	--	7,016	7,016	--	14,312	14,312
Private	23,200	--	--	--	--	--	--	15,763	15,763	--	32,156	32,156
Total	33,500	1,000	34,500	1,240,508	56,832	1,331,840	--	22,779	22,779	--	46,468	46,468
Eddy												
Public	1,200	--	--	--	--	--	--	831	831	--	1,695	1,695
Private	2,800	--	--	--	--	--	--	1,867	1,867	--	3,808	3,808
Total	4,000	100	4,100	948,428	45,232	997,760	--	2,698	2,698	--	5,503	5,503

1/ International ¼-inch rule.
2/ Gross area is U. S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory 1970, Soil Conservation Service, USDA. 3/ Non-commercial forest land not available by ownership categories.
SOURCE: USDA, Forest Service.

APPENDIX 1

State: North Dakota

Table 1 (cont'd)

County & Owner Group	Commercial Forest Land	Non-com. Forest Land 3/	Total Forest Land	Nonforest Land	Total 2/ Water Area	Gross Area	Net Volume of Growing Stock on CFL Thousand Cubic Feet			Net Volume of Sawtimber on CFL Thousand Board Feet 1/		
							Softwood	Hardwood	Total	Softwood	Hardwood	Total
Golden Valley												
Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	--	--	--	--	--	--	--	--	--	--	--	--
Total	--	--	--	648,960	--	648,960	--	--	--	--	--	--
Grant												
Public	200	--	--	[illegible]	--	--	--	154	154	--	314	314
Private	500	--	--	[illegible]	--	--	--	345	345	--	705	705
Total	700	--	700	1,062,957	6,423	1,070,080	--	499	499	--	1,019	1,019
Hettinger												
Public	100	--	--	--	--	--	--	31	31	--	63	63
Private	100	--	--	--	--	--	--	69	69	--	141	141
Total	200	--	200	725,805	395	726,400	--	100	100	--	204	204
Kidder												
Public	400	--	--	--	--	--	--	277	277	--	565	565
Private	900	--	--	--	--	--	--	623	623	--	1,269	1,269
Total	1,300	--	1,300	864,110	49,790	915,200	--	900	900	--	1,834	1,834
McHenry												
Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	--	--	--	--	--	--	--	--	--	--	--	--
Total	--	--	--	1,196,661	21,899	1,218,560	--	--	--	--	--	--
McIntosh												
Public	5,300	--	--	--	--	--	--	3,631	3,631	--	7,407	7,407
Private	12,000	--	--	--	--	--	--	8,159	8,159	--	16,642	16,642
Total	17,300	2,000	19,300	1,731,100	68,480	1,818,880	--	11,790	11,790	--	24,049	24,049
McLean												
Public	2,100	--	--	--	--	--	--	1,416	1,416	--	2,887	2,887
Private	4,700	--	--	--	--	--	--	3,180	3,180	--	6,488	6,488
Total	6,800	200	7,000	1,308,505	173,775	1,489,280	--	4,596	4,596	--	9,375	9,375
Mercer												
Public	600	--	--	--	--	--	--	369	369	--	753	753
Private	1,200	--	--	--	--	--	--	830	830	--	1,693	1,693
Total	1,800	100	1,900	663,704	44,796	710,400	--	1,199	1,199	--	2,446	2,446
Morton												
Public	1,300	--	--	--	--	--	--	923	923	--	1,883	1,883
Private	3,100	--	--	--	--	--	--	2,074	2,074	--	4,231	4,231
Total	4,400	100	4,500	1,223,560	16,100	1,244,160	--	2,997	2,997	--	6,114	6,114

1/ International ¼-inch rule.
2/ Gross area is U. S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory 1970, Soil Conservation Service, USDA. 3/ Non-commercial forest land not available by ownership categories. SOURCE: USDA, Forest Service.

State: North Dakota

County & Owner Group	Commercial Forest Land	Non-com. Forest Land 3/	Total Forest Land	Nonforest Land	Total Water 2/ Area	Gross Area	Net Volume of Growing Stock on CFL Thousand Cubic Feet			Net Volume of Sawtimber on CFL Thousand Board Feet 1/		
							Softwood	Hardwood	Total	Softwood	Hardwood	Total
Montrail												
Public	600	--	--	--	--	--	--	369	369	--	753	753
Private	1,200	--	--	--	--	--	--	830	830	--	1,693	1,693
Total	1,800	100	1,900	1,158,129	71,331	1,231,360	--	1,199	1,199	--	2,446	2,446
Oliver												
Public	900	--	--	--	--	--	--	585	585	--	1,193	1,193
Private	1,900	--	--	--	--	--	--	1,313	1,313	--	2,679	2,679
Total	2,800	100	2,900	457,919	5,741	466,560	--	1,898	1,898	--	3,872	3,872
Pierce												
Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	200	--	--	--	--	--	--	100	100	--	204	204
Total	200	--	200	655,301	37,619	693,120	--	100	100	--	204	204
Renville												
Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	--	--	--	--	--	--	--	--	--	--	--	--
Total	--	--	--	566,624	10,016	576,640	--	--	--	--	--	--
Sheridan												
Public	300	--	--	--	--	--	--	185	185	--	377	377
Private	600	--	--	--	--	--	--	414	414	--	846	846
Total	900	--	900	621,012	21,288	643,200	--	599	599	--	1,223	1,223
Slope												
Public	1,200	--	--	--	--	--	--	831	831	--	1,695	1,695
Private	2,800	--	--	--	--	--	--	1,867	1,867	--	3,808	3,808
Total	4,000	100	4,100	696,484	24,536	725,120	--	2,698	2,698	--	5,503	5,503
Stark												
Public	1,500	--	--	--	--	--	24	1,046	1,070	--	2,134	2,134
Private	3,400	--	--	--	--	--	54	2,351	2,405	--	4,795	4,795
Total	4,900	200	5,100	777,259	2,281	784,640	78	3,397	3,475	--	6,929	6,929
Stark												
Public	200	--	--	--	--	--	--	123	123	--	251	251
Private	400	--	--	--	--	--	--	277	277	--	564	564
Total	600	--	600	837,661	5,899	844,160	--	400	400	--	815	815
Ward												
Public	900	--	--	--	--	--	--	646	646	--	1,318	1,318
Private	2,100	--	--	--	--	--	--	1,452	1,452	--	2,962	2,962
Total	3,000	100	3,100	1,287,269	26,751	1,317,120	--	2,098	2,098	--	4,280	4,280

1/ International ¼-inch rule.
2/ Gross area is U. S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory 1970, Soil Conservation Service, USDA. 3/ Non-commercial forest land not available by ownership categories.
SOURCE: USDA, Forest Service.

State: North Dakota

County & Owner Group	Commercial Forest Land	Non-com. Forest Land	Total Forest Land	Nonforest Land	Total 2/ Water Area	Gross Area	Net Volume of Growing Stock on CFL Thousand Cubic Feet			Net Volume of Sawtimber on CFL Thousand Board Feet 1/		
							Softwood	Hardwood	Total	Softwood	Hardwood	Total
Williams												
Public	300	--	--	--	--	--	--	185	185	--	377	377
Private	600	--	--	--	--	--	--	414	414	--	846	846
Total	900	--	900	1,315,673	51,747	1,368,320	--	599	599	--	1,223	1,223

1/ International ¼ - inch rule.
2/ Gross area is U. S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory 1970, Soil Conservation Service, USDA.
SOURCE: USDA, Forest Service.

APPENDIX I

[illegible] Fourth Rebuttal

[illegible]

County & Owner Group	Commercial Forest Land	Non-com. Forest Land 3/	Total Forest Land	Nonforest Land	Total 2/ Water Area	Gross Area	Net Volume of Growing Stock on CFL Thousand Cubic Feet			Net Volume of Sawtimber on CFL Thousand Board Feet 1/		
							Softwood	Hardwood	Total	Softwood	Hardwood	Total
[illegible]												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	19	--	--	--	--	--	--	41	41	--	197	197
Private	4,656	--	--	--	--	--	2,990	758	3,748	9,320	3,324	12,644
Total	4,675	7,578	12,253	1,421,227	16,760	1,450,240	2,990	799	3,789	9,320	3,521	12,841
Corson												
National For.	--	--	--	31,105	--	--	--	--	--	--	--	--
Other Public	--	--	--	--	--	--	--	--	--	--	--	--
Private	9,714	--	--	--	--	--	--	4,365	4,365	--	15,785	15,785
Total	9,714	3,859	13,573	1,560,155	49,312	1,623,040	--	4,365	4,365	--	15,785	15,785
Davis												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	1,523	--	--	--	--	--	--	684	684	--	2,475	2,475
Private	--	--	--	--	--	--	--	--	--	--	--	--
Total	1,523	605	2,128	1,500,048	57,504	1,559,680	--	684	684	--	2,475	2,475
Harding												
National For.	10,400	1,300	11,700	61,789	--	--	2,000	--	2,000	3,069	--	3,069
Other Public	4,442	--	--	--	--	--	3,053	125	3,178	8,269	207	8,476
Private	1,340	--	--	--	--	--	866	122	988	2,594	484	3,078
Total	16,182	4,164	20,346	1,683,946	12,828	1,717,120	5,919	247	6,166	13,932	691	14,623
Hughes												
National For.	34,159	719	34,878	361	--	--	23,558	--	23,558	68,516	--	68,516
Other Public	1,806	--	--	--	--	--	1,308	61	1,369	3,345	127	3,472
Private	35,683	--	--	--	--	--	19,974	5,041	25,015	54,871	16,416	71,287
Total	71,648	25,729	97,377	2,113,111	7,752	2,218,240	44,840	5,102	49,942	126,732	16,543	143,275
Perkins												
National For.	--	--	--	123,987	--	--	--	--	--	--	--	--
Other Public	607	--	--	--	--	--	--	273	273	--	986	986
Private	606	--	--	--	--	--	--	272	272	--	985	985
Total	1,213	481	1,694	1,821,717	10,829	1,834,240	--	545	545	--	1,971	1,971
Ziebach												
National For.	--	--	--	--	--	--	--	--	--	--	--	--
Other Public	5,540	--	--	--	--	--	--	2,570	2,570	--	9,490	9,490
Private	--	--	--	--	--	--	--	--	--	--	--	--
Total	5,540	1,727	7,267	1,255,319	6,534	1,269,120	--	2,570	2,570	--	9,490	9,490

1/ International ¼-inch rule.
2/ Gross area is U. S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory 1970, Soil Conservation Service, USDA. 3/ Non-commercial forest land not available by ownership categories.
SOURCE: USDA, Forest Service.

APPENDIX I

State: Wyoming

Table 4 (cont'd)

County & Owner Group	Commercial Forest Land	Non-com. Forest Land	Total Forest Land	Nonforest Land	Total 2/ Water Area	Gross Area	Net Volume of Growing Stock on CFL Thousand Cubic Feet: Softwood	Hardwood	Total	Net Volume of Saw[illegible] on CFL Thousand Board Feet 1/: Softwood	Hardwood	Total
Converse												
National For.	--	--	--	158,025	--	--	--	--	--	--	--	--
Other Public	9,466	12,789	22,255	--	--	--	8,347	929	9,276	27,876	1,772	29,658
Private	21,530	12,605	34,135	--	--	--	20,845	2,105	22,950	72,295	4,870	77,165
Total Non-NFS	30,996	25,391	56,387	2,818,889	--	--	29,192	3,034	32,226	100,181	6,642	106,823
Total all owners	30,996	25,391	56,387	2,976,894	10,559	3,043,840	29,192	3,034	32,226	100,181	6,642	106,823
Crook												
National For.	54,517	12,707	67,224	193,397*	--	--	76,201	4,969	81,170	324,413	14,676	339,089
Other Public	25,486	14,276	29,762	--	--	--	13,195	1,446	14,641	41,230	2,429	43,659
Private	57,449	52,633	110,082	--	--	--	48,995	4,697	53,692	152,622	8,466	161,088
Total Non-NFS	72,935	66,909	139,844	2,328,664	--	--	62,190	6,143	68,333	193,852	10,895	204,747
Total all owners	127,452	79,616	207,068	2,522,061	11,991	2,741,120	138,391	11,112	149,503	518,265	25,571	543,836
Crook												
National For.	141,093	21,098	162,191	4,270	--	--	179,374	--	179,374	722,946	--	722,946
Other Public	25,013	58	25,071	--	--	--	21,049	2,895	23,944	69,582	5,019	74,601
Private	307,752	13,292	321,044	1,320,716	--	--	292,320	36,210	328,530	1,001,605	67,701	1,069,306
Total Non-NFS	332,765	13,350	346,115	1,331,776	--	--	313,369	39,105	352,474	1,071,187	72,720	1,143,907
Total all owners	473,858	34,448	508,306	1,324,986	20,788	1,854,080	492,743	39,105	531,848	1,794,133	72,720	1,866,853
Johnson												
National For.	154,750	82,022	236,772	90,103	--	--	299,192	--	299,192	871,914	--	871,914
Other Public	42,000	14,144	56,144	--	--	--	37,099	4,112	41,211	123,567	7,837	131,404
Private	50,185	1,572	51,757	--	--	--	48,799	4,856	53,655	168,646	11,227	179,873
Total Non-NFS	92,185	15,716	107,901	2,223,587	--	--	85,898	8,968	94,866	292,213	19,064	311,277
Total all owners	246,935	97,738	344,673	2,313,690	16,197	2,674,560	385,090	8,968	394,058	1,164,127	19,064	1,183,191
Natrona												
National For.	4,137	591	4,728	887	--	--	5,782	377	6,159	24,617	1,113	25,730
Other Public	19,380	30,090	49,470	--	--	--	16,940	1,934	18,874	56,389	3,753	60,142
Private	16,391	7,830	24,221	--	--	--	15,619	1,732	17,351	53,914	4,054	57,968
Total Non-NFS	35,771	37,920	73,691	3,330,801	--	--	32,559	3,666	36,225	110,303	7,807	118,110
Total all owners	39,908	38,511	78,419	3,331,688	26,053	3,436,160	38,341	4,043	42,384	134,920	8,920	143,840
Niobrara												
National For.	--	--	--	840*	--	--	--	--	--	--	--	--
Other Public	--	1,358	1,358	--	--	--	--	--	--	--	--	--
Private	7,878	8,088	15,966	--	--	--	7,532	854	8,386	26,671	1,941	28,612
Total Non-NFS	7,878	9,446	17,324	1,644,731	--	--	7,532	854	8,386	26,671	1,941	28,612
Total all owners	7,878	9,446	17,324	1,645,571	10,065	1,672,960	7,532	854	8,386	26,671	1,941	28,612

*Includes Thunder Basin National Grasslands

1/ International ¼ - inch rule.

2/ Gross area is U. S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory 1970, Soil Conservation Service, USDA.

SOURCE: USDA, Forest Service.

APPENDIX I

State: Wyoming

Table 4 (Continued)

County & Owner Group	Commercial Forest Land	Non-com. Forest Land	Total Forest Land	Nonforest Land	Total Water 2/ Area	Gross Area	Net Volume of Growing Stock on CFL Thousand Cubic Feet			Net Volume of Sawtimber on CFL Thousand Board Feet 1/		
							Softwood	Hardwood	Total	Softwood	Hardwood	Total
Sheridan												
National For.	233,341	44,550	277,891	116,671	--	--	382,664	3,246	385,910	1,421,303	7,284	1,428,587
Other Public	8,509	40	8,549	--	--	--	7,658	781	8,439	24,005	1,460	25,465
Private	24,666	18,073	42,739	--	--	--	24,084	2,283	26,367	80,301	5,238	85,539
Total Non-NFS	33,175	18,113	51,288	1,168,010	--	--	31,742	3,064	34,806	104,306	6,698	111,004
Total all owners	266,516	62,663	329,179	1,284,681	6,620	1,620,480	414,406	6,310	420,716	1,525,609	13,982	1,539,591
Weston												
National For.	4,660	33,219*	37,879	195,865*	--	--	4,999	--	4,999	19,071	--	19,071*
Other Public	26,735	--	26,735	--	--	--	22,656	2,875	25,531	75,291	6,032	81,323
Private	105,379	5,403	110,782	--	--	--	100,752	11,426	112,178	356,771	25,960	382,731
Total Non-NFS	132,114	5,403	137,517	1,160,253	--	--	123,408	14,301	137,709	432,062	31,992	464,054
Total all owners	136,774	38,622	175,396	1,356,118	9,606	1,541,120	128,407	14,301	142,708	451,133	31,992	483,125

1/ International ¼ - inch rule.
2/ Gross area is U. S. Bureau of Census 1970 Land and Water Area. Water areas over 40 acres include streams 1/8-mile width or more. Water area under 40 acres are from the State Conservation Needs Inventory 1970, Soil Conservation Service, USDA.
SOURCE: USDA, Forest Service.

APPENDIX I

Table 5.--Urban and built-up area statistics by states and counties

STATE: MONTANA

COUNTY	COUNTY SEAT	TOTAL URBAN & BUILT UP AREAS 1958 Acres*	1967 Acres	% CHANGE FROM 1958-1967 Total Urban & Built Up Area
1. Big Horn	Hardin	10,827	11,979	+11%
2. Carter	Ekalaka	6,629	6,784	+ 2%
3. Custer	Miles City	12,807	14,307	+12%
4. Daniels	Scobey	13,491	9,250	-31%
5. Dawson	Glendive	29,744	20,515	-31%
6. Fallon	Baker	10,307	11,347	+ 8%
7. Garfield	Jordan	34,111	16,388	-52%
8. Golden Valley	Ryegate	6,973	7,053	+ 1%
9. McCone	Circle	21,621	13,765	-36%
10. Musselshell	Roundup	13,822	14,100	+ 2%
11. Powder River	Broadus	6,139	6,200	+ 1%
12. Prairie	Terry	8,818	8,818	----
13. Richland	Sidney	12,659	12,755	+.8%
14. Roosevelt	Wolf Point	26,596	16,329	-39%
15. Rosebud	Forsyth	4,608	5,208	+13%
16. Sheridan	Plentywood	14,135	15,998	+13%
17. Treasure	Hysham	3,118	4,115	+32%
18. Valley	Glasgow	25,653	25,953	+ 1%
19. Wibaux	Wibaux	6,000	7,000	+17%
20. Yellowstone	Billings	41,033	44,333	+ 8%
TOTAL STATE AREA		309,291	272,197	-11.99%

* Acreage delineated on a County basis devoted to residential, commercial, and industrial purposes. (transportation facilities included) Does not, however, include agricultural, forest or rangeland classifications or strip mines, borrow and gravel pits.

Source: Conservation Need Inventory, 1970, Soil Conservation Service, USDA.

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Table 5 (Cont'd)

STATE: NORTH DAKOTA

COUNTY	COUNTY SEAT	TOTAL URBAN & BUILT UP AREAS 1958 Acres*	1967 Acres	% CHANGE FROM 1958-1967 Total Urban & Built Up Areas
1. Adams	Hettinger	13,338	13,538	+ 1%
2. Billings	Medora	4,989	10,964	+120%
3. Bottineau	Bottineau	29,550	29,887	+ 1%
4. Bowman	Bowman	9,643	9,644	----
5. Burke	Bowbells	16,012	20,473	+28%
6. Burleigh	Bismarck	25,121	27,346	+ 9%
7. Divide	Crosby	18,281	21,475	+17%
8. Dunn	Manning	12,536	12,536	----
9. Emmons	Linton	35,021	35,021	----
10. Golden Valley	Beach	9,362	9,395	+.4%
11. Grant	Carson	19,257	19,423	+ 1%
12. Hettinger	Mott	15,427	15,517	+ 1%
13. Kidder	Steele	11,266	11,978	+ 6%
14. McHenry	Towner	31,768	31,807	+.1%
15. McKenzie	Watford City	9,794	9,804	+.1%
16. McLean	Washburn	32,244	32,249	----
17. Mercer	Stanton	16,375	21,430	+31%
18. Morton	Mandan	18,074	18,237	+ 1%
19. Mountrail	Stanley	22,036	22,257	+ 1%
20. Oliver	Center	9,397	9,400	----
21. Pierce	Rugby	17,926	18,123	+ 1%
22. Renville	Mohall	11,931	8,624	-28%
23. Sheridan	McClusky	14,232	17,243	+21%
24. Sioux	Fort Yates	3,471	3,460	-.3%
25. Slope	Amidon	9,461	9,459	----
26. Stark	Dickinson	17,005	28,842	+70%
27. Ward	Minot	44,649	46,649	+ 4%
28. Williams	Williston	31,255	31,225	-.1%
TOTAL STATE AREA		509,421	546,006	+7.15%

* Acreage delineated on a County basis devoted to residential, commercial, and industrial purposes. (transportation facilities included) Does not, however, include agricultural, forest or rangeland classifications or strip mines, borrow and gravel pits.

Source: Conservation Need Inventory, 1970, Conservation Service, USDA.

Table 5 (Cont'd)

STATE: SOUTH DAKOTA

COUNTY	COUNTY SEAT	TOTAL URBAN & BUILT UP AREAS 1958 Acres *	1967 Acres	CHANGE FROM 1958-1967 Total Urban & Built Up Areas
1. Butte	Belle Fourche	3,780	3,780	----
2. Corson	McIntosh	3,640	5,100	+40%
3. Dewey	Timber Lake	1,843	2,563	+39%
4. Harding	Buffalo	1,356	1,410	+ 4%
5. Meade	Sturgis	14,348	14,498	+ 1%
6. Perkins	Bison	2,674	2,674	----
7. Ziebach	Dupree	1,059	1,059	----
TOTAL STATE AREA		28,700	31,084	+8.31%

* Acreage delineated on a County basis devoted to residential, commercial, and industrial purposes. (transportation facilities included) Does not, however, include agricultural, forest or rangeland classifications or strip mines, borrow and gravel pits.

Source: Conservation Need Inventory, 1970, Conservation Service, USDA.

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Table 5 (Cont'd)

STATE: WYOMING

COUNTY	COUNTY SEAT	TOTAL URBAN & BUILT UP AREAS 1958 Acres *	1967 Acres	% CHANGE [illegible] Total Urban & Built Up Areas
1. Campbell	Gillette	9,800	56,411	+475%
2. Converse	Douglas	5,400	37,595	+396%
3. Crook	Sundance	5,500	31,462	+472%
4. Johnson	Buffalo	1,700	53,108	+3,985%
5. Natrona	Casper	11,500	57,750	+402%
6. Niobrara	Lusk	6,000	15,387	+156%
7. Sheridan	Sheridan	17,700	37,525	+112%
8. Weston	Newcastle	4,600	16,270	+256%
TOTAL STATE AREA		61,800	305,608	+394.51%

* Acreage delineated on a County basis devoted to residential, commercial, and industrial purposes. (transportation facilities included) Does not, however, include agricultural, forest or rangeland classifications or strip mines, borrow and gravel pits.

Source: Conservation Need Inventory, 1970, Soil Conservation Service, USDA.

Northern Great Plains Resources Program
Surface Resources Work Group

Draft
February 1974

APPENDIX I

State Montana

Table 6.--Transportation network by states and counties

COUNTY	COUNTY SEAT	ROADS AND STREETS Net Constructed Miles: Total	Rural	Municipal	Net Change 1960-1970: Miles	%	AIRPORTS: PUBLIC LOCATIONS				PRIVATE NO.	RAILROADS: MILES OF LINE	MAIN STATIONS			
1. Big Horn	Hardin	1640	1616	24	-104	-6.0	Hardin	Fort Smith			2	95	Wyola	Lodge Grass	Crow Agency	Hardin
2. Carter	Ekalaka	880	873	7	- 12	-1.3	Ekalaka				2	0				
3. Custer	Miles City	1145	1095	50	- 86	-6.5	Miles City				2	80	Miles City	Shirley	Paragon	
4. Daniels	Scobey	872	855	17	-124	-11.3	Scobey				2	58	Flaxville	Scobey	Peerless	
5. Dawson	Glendive	1222	1186	36	-131	-9.7	Glendive	Richey			1	116	Glendive	Richey	Lindsay	Intake
6. Fallon	Baker	934	910	24	-175	-15.8	Baker				1	38	Baker	Plevna		
7. Garfield	Jordan	1390	1383	7	-124	-8.2	Jordan				7	0				
8. Golden Valley	Ryegate	675	664	11	- 21	-3.0	Ryegate	Lavina			2	69	Lavina	Ryegate		
9. McCone	Circle	1894	1885	9	+ 41	+2.2	Circle				2	29	Circle	Brockway		
10. Musselshell	Roundup	1115	1091	24	+ 41	+3.8	Roundup				0	54	Melstone	Musselshell	Roundup	
11. Powder River	Broadus	1248	1241	7	- 45	-3.5	Broadus				1	0				
12. Prairie	Terry	744	732	12	- 47	-5.[illegible]	Terry				0	76	Mildred	Terry		
13. Richland	Sidney	1426	1390	36	+ 46	+3.3	Sidney	Fairview			3	87	Sidney	Newlon Jct.	Savage	Fairvi[illegible]
14. Roosevelt	Wolf Point	1816	1772	44	+106	+6.2	Wolf Pt	Poplar	Culbertson		2	115	Bainville	Culbertson	Brockton	Wolf P[illegible]
15. Rosebud	Forsyth	1786	1769	17	- 88	-4.7	Forsyth	Ashland			2	176	Hathaway	Rosebud	Forsyth	Vanada
16. Sheridan	Plentywood	1470	1448	22	-158	-9.7	Plentywood	Medicine Lake			3	100	Medicine Lake	Antelope	Plentywood	Redstone
17. Treasure	Hysham	401	397	4	+ 20	+5.2	Hysham				1	56	Hysham	Sanders	Big Horn	
18. Valley	Glasgow	2252	2211	41	-180	-7.4	Glasgow	Avco Glasgow	Opheim	Port of Opheim	7	94	Frasier	Glasgow	Hinsdale	Opheim

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State Montana

Table 6 (Cont'd)

COUNTY	COUNTY SEAT	ROADS AND STREETS Net Contructed Miles: Total	Rural	Municipal	Net Change 1950-1970 Miles	%	AIRPORTS PUBLIC LOCATIONS				PRIVATE NO.	RAILROADS MILES OF LINE	MAIN STATIONS			
19. Wilbaux	Wilbaux	646	637	9	71	-9.9					0	17	Wilbaux	Yates		
20. Yellow-stone	Billings	2167	1878	289	+ 7	+0.3	Billings	Laurel			2	198	Laurel	Billings	Huntley	Shepherd
TOTALS		25833	25143	690	-1099	-4.1	31				43	1459	54			

SOURCE: Montana Department of Highways.

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State North Dakota

Table 6 (Cont'd)

COUNTY	COUNTY SEAT	ROADS AND STREETS Net Constructed Miles Total	Rural	Municipal	Net Change 1960-1970 Miles	%	AIRPORTS PUBLIC LOCATIONS				PRIVATE NO.	RAILROADS MILES 1/ OF LINE	MAIN STATIONS			
1. Adams	Hettinger	1069	1041	28	+47	+4.6	Hettinger	Reeder			6	9.3 46.8	Hettinger	Reeder	Bucyrus	Haynes
2. Billings	Medora	822	819	3	+279	+51.4					4	5.9 22.2	Medora			
3. Bottineau	Bottineau	2225	2155	70	+35	+1.6	Bottineau	Lansford	Westhope		8	10.8 155.2	Bottineau	Westhope	Lansford	Gardena
4. Bowman	Bowman	953	918	35	+141	+17.4	Bowman				5	9.9 46.2	Bowman	Scranton	Gascoyne	Shane
5. Burke	Bowbells	1407	1366	41	+267	+23.4	Bowbells	Columbus	Portal		5	21.2 105.9	Bowbells	Lignite	Towers Lake	Columbu
6. Burleigh	Bismarck	1951	1807	144	+86	+4.6	Bismarck				3	26.6 144.8	Bismarck	Wilton	Wing	Regan
7. Divide	Crosby	1538	1508	30	+61	+4.1	Crosby	Noonan			5	6.4 55.6	Crosby	Noonan	Ambrose	Fortuna
8. Dunn	Manning	1579	1557	22	+131	+9.0					4	3.4 30.7	Killdeer	Dunn Center	Halliday	Dodge
9. Emmons	Linton	1623	1592	31	+126	+8.4	Hazelton	Linton			5	4.3 72.8	Linton	Strasburg	Braddock	Hazelto
10. Golden Valley	Beach	903	875	28	+192	+23.2	Beach				1	6.4 40.3	Beach	Golva	Sentinel Butte	
11. Grant	Carson	1630	1596	34	+260	+19.0	Elgin				1	4.4 95.1	Elgin	Carson	Raleigh	New Leipzig
12. Hettinger	Mott	1303	1277	26	+31	+2.4	Mott	New England	Regent		3	6.1 58.2	Mott	New England	Regent	
13. Kidder	Steele	1420	1387	33	+77	+5.7	Robinson	Steele			8	9.5 61.4	Steele	Robinson	Dawson	Tuttle
14. McHenry	Towner	2455	2377	78	+85	+3.6	Drake				8	31.3 183.3	Towner	Drake	Velva	Deering
15. McKenzie	Watford City	2199	2177	22	+617	+39.0	Watford City				6	5.6 46.0	Watford City	Alexander	Arnegard	
16. McLean	Washburn	2394	2325	69	+35	+1.5	Garrison	Underwood	Washburn		11	14.2 116.7	Washburn	Underwood	Garrison	Turtle Lake

1/ Top Figures are Miles of Sidetrack; Bottom Figures Miles of Main & Branch Lines.

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Table 6 (Cont'd)

State North Dakota

COUNTY	COUNTY SEAT	ROADS AND STREETS Net Constructed Miles Total	Rural	Municipal	Net Change 1960-1970 Miles	%	AIRPORTS PUBLIC LOCATIONS				PRIVATE NO.	RAILROADS MILES OF LINE	MAIN STATIONS			
7. Mercer	Stanton	1021	982	39	+69	+7.2	Beulah	Hazen			1	21.5 53.3	Beulah	Hazen	Stanton	Zap
8. Morton	Mandan	2156	2063	93	+268	+14.2	Glen Ullin	Mandan			3	48.5 125.0	Mandan	Flasher	New Salem	Glen Ullin
9. Mountrail	Stanley	2021	1956	65	+93	+4.8	New Town	Parshall	Stanley		5	19.5 109.9	Stanley	Parshall	New Town	Plaza
10. Oliver	Center	723	717	6	+62	+9.4					1	3.7 31.7				
11. Pierce	Rugby	1490	1460	30	+26	+1.8	Rugby				2	11.3 90.1	Rugby	Barton	Wolford	Balta
12. Renville	Mohall	1135	1107	28	-63	-5.3	Glenburn	Mohall	Sherwood		2	2.7 61.8	Mohall	Glenburn	Sherwood	Tolley
13. Sheridan	McClusky	1103	1089	14	+23	+2.1					2	3.0 34.0	McClusky	Goodrich	Martin	
14. Sioux	Fort Yates	611	602	9	+112	+22.4					1	0.6 23.9	Selfridge			
15. Slope	Amidon	939	929	10	+124	+15.2						9.3 9.1	Marmarth			
16. Stark	Dickinson	1604	1521	83	+171	+11.[illegible]	Dickinson	Richardton			3	31.0 58.8	Dickinson	Belfield	Richardson	Taylo
17. Ward	Minot	2797	2605	192	+125	+4.7	Kenmare	Makoti	Minot	Ryder	6	103.3 188.2	Minot	Kenmare	Surrey	Burlingt
18. Williams	Williston	2346	2229	117	+158	+7.2	Grenora	Tioga	Wildrose	Williston	6	46.1 115.3	Williston	Tioga	Ray	Grenora
TOTALS		43,417	42,037	1,380 *	+3623	+9.1	47				115	2693.6 (2604)	95			

SOURCE: North Dakota Highway Department

APPENDIX I

State South Dakota

Table 6 (Cont'd)

COUNTY	COUNTY SEAT	ROADS AND STREETS Net Constructed Miles					AIRPORTS					RAILROADS				
		Total	Rural	Municipal	Net Change 1960-1970 Miles	%	PUBLIC LOCATIONS				PRIVATE NO.	MILES OF LINE	(AGENCY ONLY) MAIN STATIONS			
1. Butte	Belle Fourche	1010	974	36	-87	-7.9	Newell	Belle Fourche			1	20	Belle Fourche			
2. Corson	McIntosh	1959	1938	21	-663	-25.3	McIntosh	McLaughlin	Cottonwood 5 mi E.	of Bullhead		80	McLaughlin			
3. Dewey	Timber Lake	1210	1191	19	-548	-31.2	Isabel	Timber Lake		Hunt near Eagle Butte		117				
4. Harding	Buffalo	1042	1035	7	-141	-11.9	Buffalo	Camp Cook	Catron Ranch 1 mi. S.	Camp Cook		0				
5. Meade	Sturgis	1750	1720	30	-265	-13.2	10 mi. E. of Sturgis	Faith			1	28	Sturgis			
6. Perkins	Bison	1591	1566	25	-387	-19.6	Lemmon	Bison			2	12	Lemmon(15 mi. N. of Strood)	Maurino,	10 mi. S.	
7. Ziebach	Dupree	963	957	6	-350	-26.3	Dupree					23				
TOTAL		9525	9381	144	-2441	-20.4	15				4	280	4			

APPENDIX I

State Wyoming

Table 6 (Cont'd)

COUNTY	COUNTY SEAT	ROADS AND STREETS Set Up Directed Miles: Total	Rural	Municipal	Net Change 1960-1970 Miles	Net Change 1960-1970 Miles	AIRPORTS: PUBLIC LOCATIONS				PRIVATE NO.	RAILROADS: MILES OF LINE	MAIN STATIONS			
Campbell	Gillette	1569	1553	16	+94	+6.4	Gillette				6	BN-71	Belleayr	Gillette		
Converse	Douglas	1486	[illegible]	43	+300	+25.	Douglas				6	C&NW-73 BN-61	Douglas			
Crook	Sundance	1231	1217	14	+428	+53.					1	C&NW-8 BN-17	Moorcroft			
Johnson	Buffalo	1128	1116	12	+348	+44.	Buffalo				3	0				
Natrona	Casper	1926	1778	148	+395	+25.	Casper				3	C&NW-28 BN-84	Casper			
Niobrara	Lusk	914	896	18	+1	+.1	Lusk				1	C&NW-44	Lusk			
Sheridan	Sheridan	801	737	64	+187	+30.5	Sheridan				2	BN-110	Clearmont	Sheridan	Ranchester	Parkw
Weston	Newcastle	735	715	20	+200	+37.4	Newcastle				3	BN-67	New Castle	Upton		
TOTALS		9790	9455	335	+1953	+24.9	7				25	563	12			

SOURCE: Wyoming Department of Highways

BN - Burlington Northern
C&NW - Chicago & Northwestern

APPENDIX I

Table 7.--Miles of major powerlines and pipelines by states and counties

State Montana

COUNTY	COUNTY SEAT	MAJOR POWERLINES * Miles	MAJOR PIPELINES ** Miles
1. Big Horn	Hardin	270	131
2. Carter	Ekalaka	35	171
3. Custer	Miles City	45	105
4. Daniels	Scobey	0	0
5. Dawson	Glendive	185	223
6. Fallon	Baker	25	95
7. Garfield	Jordan	0	0
8. Golden Valley	Ryegate	60	77
9. McCone	Circle	125	21
10. Musselshell	Roundup	0	93
11. Powder River	Broadus	5	8
12. Prairie	Terry	60	77
13. Richland	Sidney	50	169
14. Roosevelt	Wolf Point	105	78
15. Rosebud	Forsyth	40	102
16. Sheridan	Plentywood	0	102
17. Treasure	Hysham	30	38
18. Valley	Glasgow	130	117
19. Wilbaux	Wilbaux	40	49
20. Yellowstone	Billings	200	173
MONTANA TOTAL		1,405	1,980

* 69 KV and larger (Bureau Reclamation Data)
** Interpretation of USGS Data.

APPENDIX I

Table 7 (Cont'd)

State North Dakota

COUNTY	COUNTY SEAT	MAJOR POWERLINES * Miles	MAJOR PIPELINES ** Miles
1. Adams	Hettinger	0	0
2. Billings	Medora	20	38
3. Bottineau	Bottineau	5	47
4. Bowman	Bowman	0	40
5. Burke	Bowbells	0	72
6. Burleigh	Bismarck	265	59
7. Divide	Crosby	0	11
8. Dunn	Manning	60	107
9. Emmons	Linton	130	0
10. Golden Valley	Beach	30	83
11. Grant	Carson	0	75
12. Hettinger	Mott	0	75
13. Kidder	Steele	130	53
14. McHenry	Towner	155	65
15. McKenzie	Watford City	80	275
16. McLean	Washburn	245	172
17. Mercer	Stanton	75	35
18. Morton	Mandan	120	151
19. Mountrail	Stanley	35	218
20. Oliver	Center	75	53
21. Pierce	Rugby	45	34
22. Renville	Mohall	0	15
23. Sheridan	McClusky	0	0
24. Sioux	Fort Yates	10	0
25. Slope	Amidon	0	11
26. Stark	Dickinson	80	173
27. Ward	Minot	115	316
28. Williams	Williston	85	164
NORTH DAKOTA TOTAL		1,760	2,342

* 69 KV and larger (Bureau Reclamation Data)
** Interpretation of USGS Data.

APPENDIX I

Table 7 (Cont'd)

State South Dakota

COUNTY	COUNTY SEAT	MAJOR POWERLINES * Miles	MAJOR PIPELINES ** Miles
1. Butte	Belle Fourche	115	103
2. Corson	McIntosh	90	0
3. Dewey	Timber Lake	85	0
4. Harding	Buffalo	35	77
5. Meade	Sturgis	205	59
6. Perkins	Bison	55	0
7. Ziebach	Dupree	50	0
SOUTH DAKOTA TOTAL		635	239

* 69 KV and larger (Bureau of Reclamation Data)
** State of South Dakota Data.

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APPENDIX I

Table 7 (Cont'd)

State Wyoming

COUNTY	COUNTY SEAT	MAJOR POWERLINES * Miles	MAJOR PIPELINES ** Miles
1. Campbell	Gillette	130	305
2. Converse	Douglas	210	494
3. Crook	Sundance	170	21[illegible]
4. Johnson	Buffalo	85	245
5. Natrona	Casper	570	772
6. Niobrara	Lusk	80	305
7. Sheridan	Sheridan	80	56
8. Weston	New Castle	205	269
WYOMING TOTAL		1,560	2,860

* 69 KV and larger (Bureau of Reclamation Data)
** Interpretation of USGS Data.

Table 8.--Agricultural land use statistics by states and counties

State Montana

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
1	Big Horn	Hardin	3,214,020	294,794	48,400	246,394	2,708,604	335,874	11,979
2	Carter	Ekalaka	2,118,383	133,561	13,919	119,642	1,911,878	72,064	6,784
3	Custer	Miles City	2,394,948	122,925	28,658	94,267	2,208,767	66,738	14,307
4	Daniels	Scobey	921,482	555,865	1,269	554,596	356,367	---	9,250
5	Dawson	Glendive	1,515,122	430,389	12,152	418,237	1,055,499	13,749	20,515
6	Fallon	Baker	1,043,452	254,561	2,532	252,029	777,544	---	11,347
7	Garfield	Jordan	2,848,072	154,975	3,234	151,741	2,626,303	99,440	16,388
8	Golden Valley	Ryegate	752,195	76,841	7,465	69,376	636,743	50,484	7,053
9	McCone	Circle	1,663,758	504,416	5,242	499,174	1,140,404	6,738	13,765
10	Musselshell	Roundup	1,206,195	75,360	8,124	67,236	941,886	258,513	14,100
11	Powder River	Broadus	2,102,528	154,942	13,215	141,727	1,701,876	279,168	6,200
12	Prairie	Terry	1,106,364	130,218	8,919	121,299	967,328	---	8,818
13	Richland	Sidney	1,326,416	515,732	32,316	483,416	788,678	15,361	12,755
14	Roosevelt	Wolf Point	1,523,696	737,061	6,832	730,229	762,204	9,700	16,329
15	Rosebud	Forsyth	3,220,320	148,158	34,993	113,165	2,874,806	280,269	5,208
16	Sheridan	Plentywood	1,081,376	717,809	1,328	716,481	347,569	645	15,998

1/ Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, U.S.D.A.

APPENDIX I

State: Montana

Table F (Cont'd)

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-Irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
17	Treasure	Hysham	629,343	37,176	16,209	20,967	561,793	39,349	4,115
18	Valley	Glasgow	3,178,600	747,414	35,398	712,016	2,385,694	32,497	25,953
19	Wibaux	Wibaux	568,376	152,227	458	151,769	409,149	---	7,000
20	Yellow-stone	Billings	1,690,188	340,151	80,772	259,379	1,256,772	88,649	44,333
	Total		34,100,834	6,284,575	361,435	5,923,140	26,419,864	1,649,238	272,197

Note: A. Overall Source: U.S. Census of Agriculture, 1969, plus published and unpublished Federal Agency Data.

B. Land use statistics may exceed county acreage totals due to the grazing of forested lands.

1/ Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, U.S.D.A.

APPENDIX I

State North Dakota

Table B (Cont'd)

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
1	Adams	Hettinger	632,938	392,723	331	392,392	226,477	200	13,538
2	Billings	Medora	727,344	129,849	47	129,802	575,931	12,600	10,964
3	Bottineau	Bottineau	1,067,558	929,938	116	929,822	67,233	41,800	29,887
4	Bowman	Bowman	748,586	370,910	1,323	369,587	367,532	500	9,644
5	Burke	Boubelle	705,266	493,730	---	493,730	190,663	400	20,473
6	Burleigh	Bismarck	1,038,497	552,596	4,702	547,894	453,055	5,700	27,346
7	Divide	Crosby	831,557	573,936	998	572,938	236,146	---	21,475
8	Dunn	Manning	1,275,008	487,887	1,053	486,834	741,085	34,500	12,536
9	Emmons	Linton	952,528	582,707	870	581,837	330,800	4,100	35,021
10	Golden Valley	Beach	548,960	240,124	330	239,794	309,441	---	9,395
11	Grant	Carson	1,063,657	523,559	1,875	521,684	519,975	700	19,423
12	Hettinger	Mott	726,005	599,023	135	598,888	111,265	200	15,517
13	Kidder	Steele	865,410	424,963	916	424,047	427,169	1,300	11,978
14	McHenry	Towner	1,196,661	802,679	3,129	799,550	362,175	---	31,807
15	McKenzie	Watford City	1,750,400	535,280	17,116	518,164	1,188,016	19,300	9,804
16	McLean	Washburn	1,315,505	966,678	772	965,906	309,778	7,000	32,249

1/ Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

APPENDIX I

State North Dakota

Table 8 (Cont'd)

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
17	Mercer	Stanton	665,604	343,052	1,025	342,027	299,322	1,900	21,430
18	Morton	Mandan	1,228,060	565,442	2,011	563,431	639,981	4,500	18,237
19	Mountrail	Stanley	1,140,029	725,554	555	724,999	410,418	1,900	22,257
20	Oliver	Center	460,819	208,922	2,193	206,729	239,697	2,900	9,400
21	Pierce	Rugby	655,501	547,856	---	547,856	89,322	200	18,123
22	Ransville	Mohall	566,624	461,444	316	461,128	96,556	---	8,624
23	Sheridan	McClusky	621,912	398,315	---	398,315	205,454	500	17,243
24	Sioux	Fort Yates	700,584	148,406	607	147,799	544,718	4,100	3,460
25	Slope	Amidon	782,359	296,140	218	295,922	471,860	5,100	9,459
26	Stark	Dickinson	838,261	576,244	505	575,739	232,575	600	28,842
27	Ward	Minot	1,290,369	982,596	952	981,644	258,124	3,100	46,649
28	Williams	Williston	1,316,573	844,893	13,024	831,869	439,555	900	31,225
	Total		25,832,575	14,705,446	55,119	14,650,327	10,434,323	154,400	546,006

Note: A. Overall Source: U.S. Census of Agriculture, 1969, plus published and unpublished Federal Agency Data.

B. Land use statistics may exceed county acreage totals due to the grazing of forested lands.

1/ Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

State South Dakota

Table 8 (Cont'd)

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-Irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
1	Butte	Belle Fourche	1,433,480	130,362	50,262	80,100	1,224,663	12,253	3,780
2	Corson	McIntosh	1,573,728	374,614	1,160	373,454	1,184,300	13,573	5,100
3	Dewey	Timber Lake	1,502,176	223,170	---	223,170	1,274,920	2,128	2,563
4	Harding	Buffalo	1,704,292	181,434	4,190	177,244	1,505,266	20,346	1,410
5	Meade	Sturgis	2,210,488	377,500	6,035	371,465	1,748,642	97,377	14,498
6	Perkins	Bison	1,823,411	411,640	2,384	409,256	1,407,884	1,694	2,674
7	Ziebach	Dupree	1,262,586	123,287	606	122,681	1,132,700	7,267	1,059
	Total		11,510,161	1,822,007	64,637	1,757,370	9,548,375	154,638	31,084

Note: A. Overall Source: U.S. Census of Agriculture, 1969, plus published and unpublished Federal Agency Data.

B. Land use statistics may exceed county acreage totals due to the grazing of forested lands.

1/ Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, U.S.D.A.

APPENDIX I

State Wyoming

Table 8 (Cont'd)

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-Irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
1	Campbell	Gillette	3,033,281	124,659	2,480	122,179	2,821,215	56,387	56,411
2	Converse	Douglas	2,729,129	60,340	40,920	19,420	2,503,742	207,068	37,595
3	Crook	Sundance	1,833,292	145,090	7,171	137,919	1,182,882	508,306	31,462
4	Johnson	Buffalo	2,658,363	60,336	41,629	18,707	2,297,984	344,673	53,108
5	Natrona	Casper	3,410,107	43,086	38,963	4,123	3,269,363	78,419	57,750
6	Niobrara	Lusk	1,662,895	88,302	14,601	73,701	1,551,328	17,324	15,387
7	Sheridan	Sheridan	1,613,860	118,491	60,801	57,690	1,191,328	329,179	37,525
8	Weston	Newcastle	1,521,514	56,108	5,881	50,227	1,322,262	175,396	16,370
	Total		18,472,441	696,412	212,446	483,966	16,140,104	1,716,752	305,608

Note: A. Overall Source: U.S. Census of Agriculture, 1969, plus published and unpublished Federal Agency Data.

B. Land use statistics may exceed county acreage totals due to the grazing of forested lands.

1/ Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, U.S.D.A.

Discussion draft
February 1974

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SOILS

I. INTRODUCTION

The principal objectives of the soils regional profile report are to present data about soils and the relationship between soil properties and the plant, animal, and water resources to determine: (1) the productivity of land in its current use; (2) the potential for other land uses; and (3) the suitability of the soil for final cover for surface mined land to achieve revegetation.

The soils of the study area vary widely, ranging from the gently sloping, deep, loamy soils of the glaciated northern portions to shallow, rocky, steep soils of the submountainous slopes. Some soils are very sandy; and clayey soils--formed in shale--are extensive. Some have cool soil temperatures and thick, black surface layers rich in organic matter; e.g. the Haploborolls. Others have much warmer temperatures and essentially no organic matter enriched surface layer; e.g. the Torriorthents. Still others are high in sodium; e.g. the Natrargids.

To a large degree, the properties of the soils (including their temperature and moisture content at critical periods) are the controlling factor in man's use of the land in the study area. Potential uses of land are distinctly limited by the properties of the soil. Such properties as low soil moisture content, shallow rooting zone, high sodium content, or steep slopes limit uses and exert a strong influence on such major reclamation activities as irrigation of the natural soil.

Not only are current and past uses of land influenced directly by the soils, but man's activities and uses have in turn influenced the soils. Cultivation, grazing, irrigation, urban development, and other uses introduce changes in soil properties. Some of these changes are striking. Erosion, for example, has removed surface layers and considerably changed the biota in parts of the area; irrigation has changed soil temperature and the associated biota, in addition to the soil moisture content.

Soils have unique sets of properties that are determined by many aspects of the setting, including: (1) the nature of the geologic material from which they weathered; (2) the seasonal precipitation and temperature as they influence runoff, infiltration, and the biota in a given kind of soil material; (3) the plants, animals, and micro-organisms in and on the soil that not only are determined by the properties and climatic parameters of the forming soil, but, in turn, influence the soil by adding organic material, mixing and loosening the soil, and redistributing the bases; and (4) the landform that influences the amount of runoff or accumulation of surface water. Thus, the soils influence the kind of flora and fauna and the amount of infiltration and runoff, and also are influenced by these elements.

II. PROCEDURES

In this report, information is presented graphically on two maps in Appendix E, Plates 2 and 3. Narrative discussion and tabular data describe each soil association, present tabularized characteristics and interpretive data. The map, depicting soils of the Northern Great Plains (Appendix E, Plate 2) was derived from the northwestern portion of a map entitled "Soils of the Great Plains," by Dr. A. R. Aandahl (Aandahl, 1972). This map has a scale of 1:2,500,000. The extracted portion used for this report was adjusted to a scale of 1:1,000,000.

Each soil association is discussed in a brief narrative. These soil association descriptions and the descriptions of the principal series of each were developed by the State Soil Conservation scientists of the states within the study area. The principal series within associations and interpretations of soil responses (Table 2) were likewise selected and prepared by the same individuals.

The interpretations contained in this report were developed from criteria used nationwide for soil interpretations. Attention is directed to columnar data in both Tables 1 and 2. Explanations and definitions of these data are given in the Results section of this report.

III. RESULTS

Surface mining will destroy the natural soils in the area mined, and will affect the soils in nearby areas used for roads and other facilities relating to mining. Some of the soils that would be affected are very productive for dryland farming; some are not suitable for farming and are capable of producing only a poor grade of range plants. Data in this section permit an evaluation of the soils in terms of current and potential productivity. Texture, parent material, natural soil drainage class, depth of rooting zone, available water capacity, permeability, potential frost action, shrink-swell potential, and hydrologic soil group are indicated for each of several dominant soils. Also for each dominant soil, erodibility, fertility, estimated yields, and ratings and soil features affecting several uses (including irrigated cropland, urban uses, road location, and final cover for mined land) are indicated.

In addition to providing data that will permit an evaluation of the impact of surface mining on agricultural production, data are presented that permit evaluation of (1) the relative difficulty of reclamation or rehabilitation of mined land; (2) the general kinds of grading and placement of soil materials needed for most successful reclamation; and (3) the location of urban centers and facilities to service increased population projected as a result of expanded surface mining. For these purposes, the

data included are generalized and useful only for broad planning. It is strongly urged that detailed soil surveys be prepared in advance of all proposed mining, and that the evaluations indicated above be made in detail before final plans for mining are made.

A better understanding of the complex interrelationships between the soil, the biota, and the water in the region is especially important in situations where it is necessary to predict the impact of man's activities on the land resources. Changes in any one of the resource elements will influence the others. From research and recorded field experience, our understanding of these interrelations is gradually increasing. Since 1940, soil surveys have been published for 9 of the 63 counties in the study area. These counties are:

Powder River, Montana	McKenzie, North Dakota
Treasure, Montana	Morton, North Dakota
Wibaux, Montana	Stark, North Dakota
Yellowstone, Montana	Campbell, Wyoming
Billings, North Dakota	

In addition, soil surveys for nine other counties will be published in the next 3 years:

Big Horn, Montana	Renville, North Dakota
Dawson, Montana	Butte, South Dakota
Sheridan, Montana	Harding, South Dakota
Bowman, North Dakota	Johnson, Wyoming (S. part)
Oliver, North Dakota	

The soil surveys include soil maps and detailed information about the properties of the soils (USDA, 1951). They also include current information relating soil properties and kinds of soil to the biota and water resources. Interpretations are provided that relate soil properties to farming, ranching, forest management, wildlife, recreation, and urban land uses.

The soil associations shown on the map (Appendix E, Plate 2) represent areas whose unique combination of climate, landform, vegetation, and surficial geologic materials has resulted in a distinctive kind and pattern of soils. Within each association, the range in climate is narrow. The pattern of slopes is distinctive, with a recurring pattern of slopes of similar length and shape, of depressions or potholes, or other elements of landform. The native vegetation on given kinds of soil and types of landform is uniform. The relationship between given geologic materials and soils is also essentially the same throughout the area.

A wide range in kinds of soil may occur in a soil association, but the soils occur in a distinctive pattern. The productivity, potentials, and suitabilities of the different kinds of soil may vary widely on a small scale, but on a larger scale, the pattern of occurrence of the soils gives the area a distinctive set of potentials.

Each narrative discussion of the soil associations is designed to give a reasonably vivid and concise picture of the landscape

and its soils, geology, climate, vegetation, current use, and general productivity, potentials, and limitations. Emphasis is given to a discussion of landform to provide a good general impression of the nature of the area.

Soil Characteristics and Interpretations

In Tables 1 and 2, several of the most important soil properties are indicated for each of the dominant soils in the soil association, accompanied by pertinent interpretations.

In the heading for Table 1, the state(s) in which the soil association occurs is indicated, and the approximate total extent of the soil association (in square miles) within the study area is given. Ranges for the soil association in the important climatic parameters, precipitation, potential evapotranspiration, and frost-free season are also included.

The extent of each dominant soil, in terms of percent of the area of the soil association, is indicated. Each soil is classified according to Soil Taxonomy (USDA-SCS, in press), the new comprehensive soil classification system adopted by the National Cooperative Soil Survey in 1965. It should be noted that soil temperature and soil moisture content are criteria at high levels in this classification. The formative elements (bor-, ust-, and torri-) are examples of kinds of soil named according to specific limits in these parameters that result from the soil-climate interrelations. The natra- formative element indicates soils

high in sodium. (A new publication that presents Soil Taxonomy in detail will be released soon.)

From the definition of each of the dominant soil series and local knowledge of the area of its occurrence, the following properties are presented:

Col. 4 - typical texture of surface layer.

Col. 5 - parent material (surficial geologic strata).

Col. 6 - natural soil drainage class, as defined in the Soil Survey Manual (USDA, 1951).

Based on the data cited above, soil interpretations are presented in the remainder of Tables 1 and 2 (USDA-SCS, 1971). Ratings are included for:

Col. 7 - depth of rooting zone - thickness of soil that can be penetrated by plant roots. Where the depth 60 inches is given, the depth of the rooting zone is 60 inches or more.

Col. 8 - available water capacity - the amount of water a soil can hold within the rooting zone and make available to plants. The following classes are used:

Very low	1 to 3 inches
Low	3 to 6 inches
Moderate	6 to 9 inches
High	9 to 12 inches

(The abbreviation AWC refers to "available water capacity.")

Col. 9 - permeability - the quality of a soil horizon that enables water and air to move through it, herein applied to the least permeable horizon in the soil. The following classes are used:

Very slow	Less than 0.06 inch per hour
Slow	0.06 - 0.2 " " "
Moderately slow	0.2 - 0.6 " " "
Moderate	0.6 - 2.0 inches " "
Moderately rapid	2.0 - 6.0 " " "
Rapid	6.0 - 20+ " " "

Col. 10 - potential frost action - the tendency for formation of ice lenses in the soil resulting in heaving in the soil surface and loss of soil strength after thawing.

Col. 11 - shrink-swell potential - the change in volume of a soil between dry and fully moist conditions.

Col. 12 - hydrologic soil groups - a ranking of soils into four groups, A to D,--from the most permeable soils with the highest infiltration and least runoff (A) to the least permeable soils with the lowest infiltration and highest runoff (D).

The following explanations pertaining to interpretations are applicable to Table 2.

Col. 2 - land capability subclass - the dominant soils are placed into a nationwide system that ranks soils according to their capability for agriculture, especially cultivated crops, and identifies the principal kind of soil limitation for this use (USDA-SCS, 1961). Soils in capability subclasses I through

IV are considered arable without major reclamation, with limitations increasing from soils in Class I to those in Class IV. Class V soils are not arable because of such limitations as wetness, but are not subject to erosion. Class VI soils are not arable; they are soils from which economic returns can be expected through pasture or range management practices. Class VII soils are so steep, stony, shallow, or otherwise limited, that pasture and range management either is not possible or would not normally pay. Class VIII soils are so stony, shallow, or otherwise limited, that woodland management is not normally practical; potential uses are generally limited to recreation and wildlife.

Subclasses indicate the dominant kind of soil limitation or hazard for agricultural use. The e subclass designates erosion as the dominant kind of limitation. Similarly, w denotes wetness; s denotes soil limitations in rooting zone, including shallowness, stoniness, low moisture-holding capacity, or salinity; and c denotes climatic limitations (USDA-SCS, 1961).

Col. 3 - erodibility - refers to the erodibility of the soil in its in situ natural condition. Classes are defined as:

Low	All level soils not subject to wind erosion, all soils in subclass IIe, class V, and soils in s or w subclasses with erosion hazard comparable to that of subclass IIe soils.
Medium	All soils in subclass IIIe and soils in w or s subclasses with an erosion hazard comparable to that of subclass IIIe soils.
High	All soils of subclass IVe and soils in s subclasses with a comparable erosion hazard.
Very high	All soils in VIe, VIIe subclasses and soils in s subclasses with a comparable erosion hazard.

Where wind erosion is a hazard, it is mentioned specifically.

Col. 4 - inherent fertility - the following criteria were used for rating the soils: .

Low	Soils low in available P or K, or with pH below 5.0 in the A and upper B horizons; or soils having levels of alkalinity or salinity such that choice of plants or growth of plants is severely limited.
Medium	Soils intermediate between low and high in inherent fertility.
High	Soils high in available P and K, with pH of 5.5 or more in A and upper B horizons; levels of salinity or alkalinity are sufficiently low that choices or growth of plants are not limited.

Where salinity or alkalinity is a limitation, it is mentioned in this column.

Col. 5 - estimated yields are given for the commonly grown dryland crops and for native grazeable resources under high level management. The estimates are based on research plots, field trials, range-site studies, and the experience of farmers and ranchers on specific kinds of soil.

Col. 6 - degree of soil limitation and soil features affecting

(1) irrigated cropland - the soils are rated according to the degree of limitation for irrigated cropland, and the limiting soil properties are noted.

(2) urban uses - the soils are rated according to the degree imposed by soil properties for residences with basements that are served by public sewers. The limiting soil features are noted (USDA-SCS, 1971).

(3) road location - the degree and kind of soil limitations affecting road locations are cited (USDA-SCS, 1971).

(4) final cover for mined land - the thickness of soil material from the A, B, or C horizons that is desirable or suitable for use as final cover for areas of mined land. Only material that could serve as a medium for plant growth is included. It is assumed that this material would be stockpiled and spread over leveled mine spoil. Not included are horizons of calcium accumulation (Cca horizons) so

high in carbonates as to cause difficulty in establishing and maintaining plant cover; no horizons below such Cca horizons are included.

Under suitability, content of sand, gravel, stones, clay, salts, or carbonates, or low fertility result in ratings other than good. Limiting soil features are cited.

Limitations of Soil as Cover for Surface Mined Areas

Some soils are so shallow or high in sand, clay, or salt content that they are poorly suited for final cover for surface mined areas. Such soils cover about 30,500 square miles, or about 24 percent, of the region as indicated in Appendix E, Plate 3. Soils less than 20 inches to bedrock are included, as are soils with sand or heavy clay texture and high salt content.

In many of these areas, the upper 10 to 20 inches of the natural soil is more favorable for final cover than any of the underlying strata. However, it is especially important in such areas to analyze the geologic strata above the coal and identify the material that should be placed just below the replaced surface soil. By careful placement of materials, it may be possible in much of this area to create a deeper soil with broader use potentials and higher productivity than the soil that existed before mining.

A similar opportunity may exist for some soils judged to be only fair for final cover of mined land. Such soils are 20 to 40 inches to bedrock, or have loamy sand or clay texture or substantial salt content. Areas of such soils are shown in Appendix E, Plate 3, and cover about 49,000 square miles or 37 percent of the region.

The remainder of the region has soils that are well suited for final cover of mined land. In order to create the best possible soil for future use, at least 40 inches of the upper portion of the soil should be graded over the surface, with the material from the subsoil placed first over the graded spoil, and then the material from the A horizon placed on top.

The above definitions of good, fair, and poor suitability are based upon soil requirements for plant growth. In general, on soils well suited for final cover in the study area, if proper stockpiling and grading are done, the final soil will be productive for both irrigated and dryland crops. On soils with fair or poor suitability for final cover, it is more difficult or impossible to create such a productive final soil.

Information in this section does not replace the need for detailed on-site soil surveys and geologic studies for planning the placement of materials.

Soil Association Descriptions

1. Kelvin-Bottineau-Rolla association

Undulating to rolling, well drained and moderately well drained, medium and fine textured soils on glacial till plains

This soil association consists of the wooded and formerly wooded area of the Turtle Mountains. Topography is mostly undulating to rolling, with numerous depressions and small lakes. Some of the slopes are smoothly rounded and of moderate length; others are short and abrupt. Also included are smooth plateau-like landscapes. In these areas, the soils are formed in lake-laid clays or clayey glacial till. The soils in most of the area, however, are formed in loam to clay loam glacial till.

The Kelvin series occurs on undulating to rolling slope positions, and typically occupies concave, lower slopes. Kelvin soils have a thin black loam surface layer which is underlain by gray and light-gray clay loam. The subsoil is grayish-brown and light brownish-gray clay loam. The underlying material is loam or clay loam glacial till.

The Bottineau series typically occupies the higher, convex parts of the landscape, It has a very dark-gray loam surface layer about 7 inches thick and a grayish-brown clay loam subsoil. The underlying material is light brownish-gray clay loam.

The moderately well drained Rolla series occupies nearly level to gently sloping plateau-like landscapes. It has a thin black silty clay loam surface layer which is underlain by light gray silty clay loam.

The subsoil is light gray and olive-gray clay. The underlying material is calcareous light olive-gray clay, In cultivated fields, the surface soil of the Rolla and Kelvin soils is gray; Bottineau soils are black.

These soils are used for pasture, woodland pasture, and cropland. They comprise good to fair cropland and excellent pastureland if cleared of trees and shrubs; poor pastureland if densely wooded. Fertility and organic matter content are moderate to hign. Available water capacity is high. Most farms are combination feed grain-livestock enterprises. The more sloping cultivated areas are moderately susceptible to water erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 1 . Kelvin - Bottineau - Rolla association: Undulating to rolling, well drained and moderately well drained, medium and fine textured soils on glacial till plains (description)

State North Central North Dakota ; Extent 170 square miles; Average Annual Precipitation 16-17 inches;

Potential Evapotranspiration 22 inches; Average Frost-free Season 110 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Kelvin	35	Boralfic Argiborolls, fine-loamy, mixed	Loam	Clay loam glacial till	Well drained	60"	High	Moderately slow	Moderate	High	C
Bottineau	30	Udic Argiborolls, fine-loamy, mixed	Loam	Clay loam glacial till	Well drained	60"	High	Moderately slow	Moderate	High	C
Rolla	15	Typic Eutroboralfs, fine, montmorillonitic	Silty clay loam	Lacustrine clays	Moderately well drained	60"	High	Slow	Moderate	High	C

Table 2.--Soil Characteristics and Interpretations; Soil Association 1

Northern Great Plains Resources Program, Surface Resources Work Group

Draft
February 1974

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Spring Wheat units: bu/ac	(2) Barley bu/ac	(3) Oats bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Kelvin loam 3 to 6 percent slopes	IIe	Low	High	33	53	69	2300	Favorable	Severe--Shrink-swell, Low strength	Severe--Shrink-swell, Low strength	60	25" good 35" fair--moderate lime
Pottineau loam, 6 to 9 percent slopes	IIIe	Medium	High	27	43	58	2800	Favorable	Severe--Low strength Shrink-swell	Severe--Low strength, Shrink-swell	60	25" good 35" fair--moderate lime
Rolla silty clay loam, 3 to 6 percent slopes	IIe	Low	Medium	29	46	61	(Woodland)	Slow permeability	Severe--Shrink-swell, Low strength	Severe--Shrink-swell, Low strength	60	Poor--clayey

1/ Ratings are given for residences, with basements, that are served by public sewers.

7. Glyndon-Bearden-Overly association

Level, moderately well drained, and somewhat poorly drained, medium textured, and moderately fine textured soils on glacial lake plains

This association consists of a nearly level glacial lake plain. Slopes are usually less than 2 percent, but some steeper areas occur on breaks to drainageways and streams. Surface drainage is weakly developed and poor, except adjacent to streams which flow through parts of the association.

The Bearden series occupies convex positions that are 6 to 12 inches higher than the associated Gardena and Overly soils. It has a black silty clay loam surface layer about 8 inches thick, underlain by very dark gray, gray, and light olive-brown silty clay loam that contains a large amount of lime. This grades to light brownish-gray silt loam at a depth of about 39 inches.

The somewhat poorly drained Glyndon series also occupies slightly higher convex positions similar to the Bearden. It has a black silt loam surface layer about 6 inches thick, underlain by very dark gray and gray silt loam that contains a large amount of lime. This grades to loamy very fine sand at a depth of about 24 inches.

The moderately well drained Gardena and Overly series occupy smooth, nearly level areas. Gardena soils have a very dark gray silt loam surface layer about 15 inches thick and a dark grayish-brown silt loam subsoil. The underlying material is pale brown and light yellowish-brown calcareous silt loam. The Overly soils have a very dark gray silty clay loam surface layer about 10 inches thick and a dark gray silty clay loam subsoil. The underlying material is light yellowish-brown silty clay loam.

Most of these soils are used for cropland. Fertility and organic matter contents are high. Available water capacity is high. Most farms are cash grain enterprises. Early spring wetness and slow surface drainage are the main limitations.

Table 1 . Soil Characteristics and Interpretations

Soil Association 7 . Glyndon - Bearden - Overly association: Level, moderately well drained and somewhat poorly drained, medium textured and moderately fine textured soils on glacial lake plains (description)

State North Central North Dakota ; Extent 326 square miles; Average Annual Precipitation 16-17 inches;

Potential Evapotranspiration 22 inches; Average Frost-free Season 110 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Glyndon	30	Aeric Calciaquolls, coarse-silty, frigid	Silt loam	Stratified glacio-lacustrine sediments	Moderately well and somewhat poorly drained	60"	High	Moderate	High	Low	B
Bearden	25	Aeric Calciaquolls, fine-silty, frigid	Silty clay loam	Silty glacio-lacustrine sediments	Somewhat poorly drained	60"	High	Moderate slow	High	High	C
Overly	20	Pachic Udic Haploborolls, fine-silty, mixed	Silty clay loam	Silty glacio-lacustrine sediments	Moderately well drained	60"	High	Moderately slow	High	High	C
Gardena	15	Pachic Udic Haploborolls, coarse-silty, mixed	Silt loam	Stratified glacio-lacustrine sediments	Moderately well drained	60"	High	Moderate	High	Low	B

Table 2.--Soil Characteristics and Interpretations; Soil Association 7

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Spring Wheat (2) Barley (3) Oats units: bu/ac	bu/ac	bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Lands (1) Inches available	(2) Suitability
Glyndon silt loam, 0 to 2 percent slopes	IIe	Medium-Severe wind erosion	Medium	38	61	80	2800	Favorable High available water capacity	Severe--Wet	Severe--Frost action	60	Good
Bearden silty clay loam, 0 to 2 percent slopes	IIe	Medium-Severe wind erosion	Medium	38	61	80	2850	Favorable	Severe--Wet, Shrink-swell, Low strength	Severe--Frost action, Shrink-swell, Low strength	60	Fair--clayey
Overly silty clay loam, 0 to 2 percent slopes	IIe	Low	High	40	64	84	2700	Favorable	Severe--Shrink-swell, Low strength	Severe--Frost action, Shrink-swell	60	Fair--clayey
Gardena silt loam, 0 to 2 percent slopes	IIe	Medium-Severe wind erosion	High	40	64	84	2750	Favorable	Moderate Low strength	Severe--Frost action	60	Good

1/ Ratings are given for residences, with basements, that are served by public sewers.

9. Bearden-Fargo-Gardena association

Level, poorly drained, and somewhat poorly drained, fine textured and moderately fine textured soils on glacial lake plains

This association consists of a nearly level glacial lake plain. Slope gradients are mainly less than 2 percent. Surface drainage is poor. Where the soils occur near the outer margin of lake basins, glacial till often underlies the lake sediments at depths of 2 to 5 feet.

The poorly drained Fargo series occupies the lower positions in the landscape. It has a black clay surface layer about 9 inches thick and an olive-gray clay subsoil. The underlying material is olive-gray calcareous clay.

The somewhat poorly drained Bearden series occupies the slightly higher positions. It has a black silty clay loam surface layer about 8 inches thick. This is underlain by very dark gray, gray, and light olive-brown silty clay loams that contains a large amount of lime. This grades to light brownish-gray silt loam at a depth of about 39 inches.

The somewhat poorly drained Hegne series is also an important soil in this association. It occurs on slight rises in association with the Fargo soils.

Most of these soils are used for cropland. Fertility and organic matter contents are high. Available water capacity is high. Most farms are cash grain enterprises. Poor surface drainage and wetness are the main problems. Fargo and Hegne soils have a narrow range of moisture contents at which they can be tilled.

Table 1 . Soil Characteristics and Interpretations

Soil Association 9 . Bearden - Fargo - Gardena association: Level, poorly drained and somewhat poorly drained, fine textured and moderately fine textured soils on glacial lake plains (description)

State North Central North Dakota ; Extent 224 square miles; Average Annual Precipitation 16-17 inches;

Potential Evapotranspiration 22 inches; Average Frost-free Season 110 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Bearden	25	Aeric Calciaquolls, fine-silty, frigid	Silty clay loam	Silty glacio-lacustrine sediments	Somewhat poorly drained	60"	High	Moderately slow	High	High	C
Fargo	20	Vertic Haplaquolls, fine, montmorillonitic, frigid	Silty clay	Lacustrine clay	Poorly drained	60"	High	Slow	High	High	D
Glyndon	15	Aeric Calciaquolls, coarse-silty, frigid	Silt loam	Stratified glacio-lacustrine sediments	Moderately well and somewhat poorly drained	60"	High	Moderate	High	Low	B
Gardena	15	Pachic Udic Haploborolls, coarse-silty, mixed	Silt loam	Stratified glacio-lacustrine sediments	Moderately well drained	60"	High	Moderate	High	Low	B
Overly	10	Pachic Udic Haploborolls, fine-silty, mixed	Silty clay loam	Silty glacio-lacustrine sediments	Moderately well drained	60"	High	Slow	High	High	C
Hegne	5	Typic Calciaquolls, fine, frigid	Silty clay	Lacustrine clay	Poorly drained	60"	High	Slow	High	High	D

Table 2.--Soil Characteristics and Interpretations; Soil Association 9.

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Wheat (2) Barley (3) Oats units: bu/ac	bu/ac	bu/ac	b. Native Grazeable sources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Bearden silty clay loam, 0 to 2 percent slopes	IIes	Medium-Severe wind erosion	Medium	38	61	80	2850	Favorable	Severe--Shrink-swell, Low strength, wet	Severe--Frost action, Shrink-swell, Low strength	60	Fair--clayey
Fargo silty clay, 0 to 2 percent slopes	IIw	Low	High	35	56	73	2700	Slow permeability	Severe--Wet, Shrink-swell, Low strength	Severe--Frost action, Shrink-swell, Wet	60	Poor--high in clay
Glyndon silt loam, 0 to 2 percent slopes	IIes	Medium--Severe wind erosion	Medium	38	61	80	2800	Favorable High available water capacity	Severe--Wet	Severe--Frost action	60	Good
Gardena silt loam, 0 to 2 percent slopes	IIe	Medium--Severe wind erosion	High	40	64	84	2750	Favorable	Moderate Low strength	Severe--Frost action	60	Good
Overly silty clay loam, 0 to 2 percent slopes	IIc	Low	High	40	64	84	2700	Slow permeability	Severe--Shrink-swell, Low strength	Severe--Shrink-swell, frost action, Low strength	60	Fair clayey
Hegne silty clay, 0 to 2 percent slopes	IIw	Low	Medium	31	50	65	2750	Slow permeability	Severe--Shrink-swell, Wet, Low strength	Severe--Frost action, Shrink-swell, Wet	60	Poor--high in clay

1/ Ratings are given for residences, with basements, that are served by public sewers.

10. Arvilla-Renshaw-Sioux association

Level, well drained, and somewhat excessively drained, medium textured soils on gravelly terraces and glacial outwash channels

This soil association consists of nearly level to gently undulating outwash plains and glacial stream terraces. The soils formed in medium textured sediments overlying sand and gravel at depths of 10 to 40 inches.

Fordville and Renshaw series are the dominant soils. They occupy similar positions on the landscape. The Fordville soils have a very dark gray loam surface layer about 6 inches thick and a dark gray and dark grayish-brown loam subsoil, underlain by grayish-brown sand and gravel at a depth of about 27 inches.

The Renshaw soils have a dark gray loam surface layer about 7 inches thick and a dark grayish-brown loam subsoil, underlain by grayish-brown sand and gravel at a depth of about 15 inches.

Other important soils in this association are the Arville, Sioux, and Hecla soils. The Arvilla soils are moderately coarse textured in the upper part, and are underlain by sand and gravel at depths of 16 to 40 inches. They occupy similar positions on the landscape as the Fordville and Renshaw soils. The Sioux soils occupy the more undulating parts of the landscape on convex slopes, ridges, and terrace edges. They are underlain by sand and gravel at depths of 10 inches or less. The deep, coarse textured Hecla soils are on gently undulating positions, and are most extensive in the southern part of the association.

Most of this association is used for cropland; however, areas dominated by Sioux soils are in native grass. Fertility is low to high,

and the organic matter content is moderate to high. Available water capacity is very low to moderate. Most farms are combination feed grain-livestock and cash grain enterprises. Limitations are the limited moisture-holding capacity of the Renshaw and Sioux soils and the susceptibility to soil blowing of the Hecla soils.

Table 1 . Soil Characteristics and Interpretations

Soil Association 10 . Arvilla - Renshaw - Sioux association: Level, well drained and somewhat excessively drained, medium textured soils on gravelly terraces and glacial outwash channels (description)

State Central North Dakota ; Extent 402 square miles; Average Annual Precipitation 16-17 inches;

Potential Evapotranspiration 23 inches; Average Frost-free Season 115 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Arvilla	25	Udic Haploborolls, sandy, mixed	Sandy loam	Sandy glacial outwash	Somewhat excessively drained	60"	Low	Moderately rapid	Low	Low	B
Renshaw	20	Udic Haploborolls, fine-loamy over sandy or sandy-skeletal, mixed	Loam	Sand and gravel glacial outwash	Somewhat excessively drained	60"	Low	Moderately rapid	Low	Low	B
Sioux	15	Udorthentic Haploborolls, sandy-skeletal, mixed	Loam	Sand and gravel glacial outwash	Excessively drained	60"	Very low	Very rapid	Low	Low	A
Fordville	10	Pachic Udic Haploborolls, fine-loamy over sandy or sandy-skeletal, mixed	Loam	Loamy alluvium, over sand and gravel	Well drained	60"	Moderate	Moderate	Moderate	Low	B
Hecla	5	Udic Haploborolls, sandy, mixed	Loamy fine sand	Eolian sands	Moderately well drained	60"	Low	Rapid	Low	Low	A
Barnes	5	Udic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B

Table 2.--Soil Characteristics and Interpretations; Soil Association 10

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Winter Wheat units: bu/ac	(2) Barley bu/ac	(3) Oats bu/ac	b. Native Grazeable Resources p.../acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Arvilla sandy loam, 0 to 3 percent slopes	IIIe	Medium	Low	18	29	38	1650	Low available water capacity	Slight	Slight	16	Fair--sandy
Renshaw loam, 0 to 3 percent slopes	IIIs	Low	Low	18	29	38	1600	Low available water capacity	Slight	Slight	15	Good
Sioux loam, 0 to 3 percent slopes	VIs	Low	Low	--	--	--	950	Very low available water capacity	Slight	Slight	8	Good
Fordville loam, 0 to 3 percent slopes	IIIs	Low	Medium	25	40	53	2250	Moderate available water capacity	Slight	Moderate--Low strength, Frost action	24	Good
Hecla loamy fine sand, 0 to 3 percent slopes	IVe	High--Severe wind erosion	Medium	29	46	61	3200	Low available water capacity	Slight	Slight	60	Poor--sandy
Barnes loam, 3 to 6 percent slopes	IIe	Low	Medium	33	53	69	2500	Favorable	Moderate Shrink-swell, Low strength	Moderate--Shrink-swell, Low strength, Frost action	18	Good

1/ Ratings are given for residences, with basements, that are served by public sewers.

12. Barnes-Buse-Svea association

Undulating to rolling, well drained, and moderately well drained, medium textured soils on glacial till plains

This soil association occupies undulating to hilly topography on the glacial till plain. Surface drainage consists of runoff into depressions. Slopes are usually short and irregular with gradients ranging from 3 to 15 percent.

Barnes, Svea, and Buse series are the dominant soils. The Barnes series occupies the plane and convex side slopes and the convex crests of the wider knolls and ridges. It has a very dark gray loam surface layer about 6 inches thick and a brown loam subsoil. The underlying material is light yellowish-brown loam glacial till.

The Svea series occupies the concave side slopes and foot slopes of the knolls and ridges. It has a very dark gray loam surface layer about 10 inches thick and a dark grayish-brown loam subsoil. The underlying material is light yellowish-brown loam glacial till.

The Buse series occupies the convex crests and steeper side slopes of the hills, ridges, and knolls. It has a very dark gray loam surface layer about 7 inches thick, underlain by calcareous, light yellowish-brown loam.

The other important soil in this association is the poorly drained Tonka soil in shallow depressions.

The soils are used for pasture and cropland. The more hilly areas are usually in native grass. Fertility is low to high, and the organic matter content is moderate to high. Available water capacity is high. Most farms are combination feed grain-livestock and cash grain enterprises. The intermittent ponding of the Tonka soils interferes with farming operations. Soils on slopes steeper than 6 percent have a moderate water erosion hazard.

Table 1 . Soil Characteristics and Interpretations

Soil Association 10 . Barnes - Buse - Svea association: Undulating to rolling, well drained and moderately well drained, medium textured soils on glacial till plains (description)

State Central North Dakota . Extent 321 square miles; Average Annual Precipitation 17-18 inches;

Potential Evapotranspiration 22 inches; Average Frost-free Season 110 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Barnes	30	Udic Haploboroll, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Buse	20	Udorthentic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Svea	15	Pachic Udic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Moderately well drained	60"	High	Moderately slow	Moderate	Moderate	B
Tonka	5	Argiaquic Argialboolls, fine-montmorillonitic, frigid	Silt loam	Loamy alluvium and loamy glacial till	Poorly drained	60"	High	Slow	High	High	C
Renshaw	5	Udic Haploborolls, fine-loamy over sandy or sandy-skeletal, mixed	Loam	Sand and gravel glacial outwash	Somewhat excessively drained	60"	Low	Moderately rapid	Low	Low	B
Lamoure	5	Cumulic Haplaquolls, fine-silty, mixed (calcareous), frigid	Silty clay loam	Silty alluvium	Poorly drained	60"	High	Moderate	High	Moderate	C
Other soils	20										

Table 2.--Soil Characteristics and Interpretations; Soil Association 12

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (High management) a. Cropland (specify crops) (1) Corn units: bu/ac	(2) Barley bu/ac	(3) Oats bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Barnes loam, 3 to 6 percent slopes	IIe	Low	Medium	33	53	69	2500	Favorable	Moderate--Low strength Shrink-swell	Moderate--Shrink-swell, Frost action, Low strength	60	18" good; 42" fair; moderate lime
Buse loam, 9 to 15 percent slopes	VIe	Very high	Low	--	--	--	2150	Slope	Moderate--Low strength	Moderate--Low strength, Frost action	60	7" good; 53" fair; moderate lime
Svea loam, 0 to 3 percent slopes	IIc	Low	High	38	61	80	3050	Favorable	Moderate Low strength	Moderate--Low strength, Frost action	60	21" good; 39" fair; moderate lime
Tonka silt loam, 0 to 2 percent slopes	IIw	Low	High	30*	48*	63*	3425	Poorly drained	Severe--Wet	Severe--Wet, Shrink-swell, Low strength	60	20" good; 40" fair; clayey
Renshaw loam, 0 to 3 percent slopes	IIIs	Low	Low	18	29	38	1650	Low available water capacity	Slight	Moderate--Low strength	15	Good
Lamoure silty clay loam, 0 to 2 percent slopes	IIw	Low	High	30*	48*	63*	4250	Poorly drained, floods	Severe--floods wet	Severe--Wet, Low strength	60	Fair; clayey and moderate lime

1/ Ratings are given for residences, with basements, that are served by public sewers.

* Yields given for drained areas.

15. Barnes-Hamerly-Svea association

Level to undulating, well drained, moderately well drained, and somewhat poorly drained, medium textured soils on glacial till plains

This association consists of a level to gently undulating till plain with dominant slopes of 2 to 8 percent. Surface drainage is poorly developed. There are a few weakly entrenched streams. In the areas between the streams, surface drainage is largely into the numerous small depressions.

The Barnes series is dominant and occupies the nearly level and gentle plane and convex slopes. It has a very dark gray loam surface layer about 6 inches thick and a brown loam subsoil. The underlying material is light yellowish-brown loam glacial till.

The Svea series occupies the concave side slopes and foot slopes of gentle knolls and ridges. It has a very dark gray loam surface layer about 10 inches thick and a dark grayish-brown loam subsoil. The underlying material is light yellowish-brown loam glacial till.

The Hamerly series, representative of the Calciaquolls, occupies the lower positions, usually the slight convex rises adjacent to the depressions. It has a very dark gray, calcareous loam surface layer about 8 inches thick, underlain by light brownish-gray loam that contains a large amount of lime.

Other important soils in this association are in the Buse and Tonka series. Buse soils are on the steeper convex crests of knolls and ridges. Tonka soils occupy the shallow depressions.

Most of the association is used for cropland. Fertility is moderate to high, and organic matter content is high. Available water capacity is high. Most of the farms are cash grain enterprises. Limitations are moderate susceptibility to water erosion on slopes above 3 percent, wetness in early spring on the Hamerly soils, and the intermittent ponding of the Tonka soils.

Table 1 . Soil Characteristics and Interpretations

Soil Association 15 . Barnes - Hamerly - Svea associations: Level to undulating, well drained, moderately well drained, and somewhat poorly drained, medium and fine soils on glacial till plains (description)

State North central North Dakota ; Extent 3264 square miles; Average Annual Precipitation 16-17 inches;

Potential Evapotranspiration 22 inches; Average Frost-free Season 115 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Barnes	30	Udic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Hamerly	25	Aeric Calciaquolls, fine-loamy, frigid	Loam	Loamy glacial till	Mod. well and somewhat poorly drained	60"	High	Moderately slow	High	Moderate	C
Svea	15	Pachic Udic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Mod. well drained	60"	High	Moderately slow	Moderate	Moderate	B
Buse	5	Udorthentic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Tonka	5	Argiaquic Argialbolls, fine, montmorillonitic frigid	Silt loam	Loamy alluvium & loamy glacial till	Poorly drained	60"	High	Slow	High	High	C
Parnell	5	Typic Argiaquolls, fine, montmorillonitic, frigid	Silty clay loam	Loamy and clayey alluvium from glacial till	Very poorly drained	60"	High	Slow	High	High	D
Other soils	15										

Table 1.--Soil Characteristics and Interpretations; Soil Association 15

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Wheat (2) Barley (3) Oats units: bu/ac	bu/ac	bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Barnes loam, 0 to 3 percent slopes	IIc	Low	Medium	33	53	69	2500	Favorable	Moderate Low strength Shrink-swell	Moderate--Frost action, Shrink-swell, Low strength	60	18" - good; 32" - fair; moderate lime
Hamerly loam, 0 to 3 percent slopes	IIe	Low	Medium	33	53	69	2650	Favorable	Severe--Wet	Severe--Frost action	60	8" - good; 52" - fair; moderate lime
Svea loam, 0 to 3 percent slopes	IIc	Low	High	38	61	80	3050	Favorable	Moderate Low strength, Shrink-swell	Moderate--Low strength, Frost action Shrink-swell	60	21" - good; 39" - fair; moderate lime
Buse loam, 6 to 9 percent slopes	IVe	High	Low	14	22	29	2150	Favorable	Moderate Low strength Shrink-swell	Moderate--Low strength, Frost action, Shrink-swell	60	Fair; moderate lime
Tonka silt loam, 0 to 2 percent slopes	IIw	Low	High	30*	48*	63*	3425	Poorly drained	Severe--Wet, Shrink-swell	Severe--Shrink-swell, Wet, Frost action	60	20" - good; 50" - fair clayey
Parnell silt; clay loam, 0 to 2 percent slopes	IIIw	Low	High	30*	48*	63*	6075	Very poorly drained	Severe--Wet, Shrink-swell	Severe--Wet, Shrink-swell, Frost action	60	Fair; clayey

1/ Ratings are given for residences, with basements, that are served by public sewers.

* Yields given for drained areas.

16. Hamar-Hecla-Wyndmere association

Level, moderately well drained, somewhat poorly drained, and poorly drained, moderately coarse and coarse textured soils on glacial lake basins and outwash plains

This association consists of a nearly level to very gently undulating glacial lake basin and outwash plain. Surface drainage is lacking. Little runoff occurs because of rapid infiltration and percolation to a ground water table.

The moderately well drained Embden series occupies the slightly higher, convex landscape positions. It has a very dark gray fine sandy loam surface layer about 14 inches thick and a dark grayish-brown fine sandy loam subsoil. The underlying material is light gray and pale yellow, calcareous fine sandy loam.

The moderately well to somewhat poorly drained Wyndmere series, occupies the concave positions. It has a black fine sandy loam surface layer about 8 inches thick, underlain by very dark gray and gray fine sandy loam containing large amounts of lime. This grades to light olive-brown fine sandy loam.

The poorly to somewhat poorly drained Hamar series occupies concave positions. It has a very dark gray loamy fine sand surface layer about 16 inches thick, underlain by mottled loamy fine sand. The underlying material is grayish-grown fine sand that is strongly mottled.

Other important soils in this association are the Hecla soils. The moderately well drained, coarse textured Hecla soils occupy convex positions.

The soils are used as pasture and cropland. Undulating areas dominated by coarse textured soils are usually in native grass. Fertility and organic matter content is moderate to high. Available water capacity is low to moderate. Most farms are combination feed grain-livestock enterprises. Soil blowing and a seasonal high water table are the main limitations in this association.

Table 1 . Soil Characteristics and Interpretations

Soil Association 20 . Hamar - Hecla - Wyndmere association: Level, moderately well drained, somewhat poorly drained, and poorly drained, moderately coarse and coarse textured soils on glacial lake basins and outwash plains (desc

State North central North Dakota ; Extent 1648 square miles; Average Annual Precipitation 16-17 inches;

Potential Evapotranspiration 22 inches; Average Frost-free Season 110 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Hecla	20	Udic Haploboroll, sandy, mixed	Loamy fine sand	Eolian sands	Moderately well drained	60"	Low	Rapid to moderately rapid	Low	Low	A
Hamar	20	Typic Haplaquolls, sandy, mixed frigid	Loamy fine sand	Eolian sands	Poorly and somewhat poorly drained	60"	Low	Rapid to moderately rapid	Moderate	Low	B
Wyndmere	10	Pachic Udic Haploborolls, coarse-loamy, frigid	Fine sandy loam	Loamy and sandy glacio-lacustrine sediments	Moderately well and somewhat poorly drained	60"	Moderate	Moderately rapid	High	Low	B
Embden	10	Pachic Udic Haploborrols, coarse-loamy, mixed	Fine sandy loam	Loamy and sandy glacio-lacustrine sediments	Moderately well drained	60"	Moderate	Moderately rapid	Low	Low	B
Maddock	10	Udorthentic Haploborolls, sandy, mixed	Loamy fine sand	Eolian sands and glacio-lacustrine sediments	Well drained	60"	Low	Rapid	Low	Low	A

Table 2.--Soil Characteristics and Interpretations; Soil Association 16

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Cropland (specify crops) (1) Wheat (2) Barley (3) Oats units: bu/ac	bu/ac	bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Lands: (1) Inches available	(2) Suitability
Hecla loamy fine sand, 0 to 3 percent slopes	IVe	High; severe wind erosion	Medium	29	46	61	3200	Low available water capacity	Slight	Slight	60	Poor; sandy
Humar loamy fine sand, 0 to 3 percent slopes	IVw	Medium	Medium	21	34	44	4275	Poorly drained	Severe--wet	Severe--wet	60	Poor; sandy
Wyndmere fine sandy loam, 0 to 2 percent slopes	IIIe	Medium	Medium	29	46	61	3100	High water table	Severe--wet	Severe--wet, frost action	60	15" - good; 45" - fair; moderate lime
Embden fine sandy loam, 0 to 3 percent slopes	IIIe	Medium	Medium	30	48	63	2850	Moderate available water capacity	Slight	Moderate--Low strength	60	30" - good; 30" - fair; moderate lime
Maddock loam, fine sand, 3 to 6 percent slopes	IVe	High; severe wind erosion	Low	18	29	38	2575	Low available water capacity	Slight	Slight	60	14" - fair sandy 46" -poor; high in sand

1/ Ratings are given for residences, with basements, that are served by public sewers.

19. Williams-Bowbells association

Level to undulating, well drained, and moderately well drained, medium textured soils on glacial till plains

This soil association consists of a broad, nearly level to undulating glacial till plain. Slopes are complex and range mostly from 1 to 8 percent. Surface drainage is partially developed and considerable surface runoff drains into the depressions.

The Williams series is dominant and occupies the well drained plane and convex side slopes and broad, slightly convex crests of knolls and ridges. It has a dark grayish-brown loam surface layer about 6 inches thick and a brown and grayish-brown clay loam subsoil.

The moderately well drained Bowbells series occupies the concave side slopes and foot slopes of the knolls and ridges. It has a dark grayish-brown loam surface layer about 6 inches thick and a dark grayish-brown and grayish-brown clay loam subsoil. The underlying material is pale yellow and light yellowish-brown loam.

Other important soils in this association are the Zahl and Tonka soils. Zahl soils are on the steeper convex crests of knolls and ridges. Tonka soils are in the shallow depressions.

Most of the soils are used for cropland. Fertility and organic matter content is moderate. Available water capacity is high. Cash grain crops are the main enterprise. Moderate susceptibility to water erosion is the principal limitation.

Table 1 . Soil Characteristics and Interpretations

Soil Association 12 . Williams - Bowbells association: Level to undulating, well drained and moderately well drained, medium textured soils on glacial till plains (description)

State Northwestern North Dakota ; Extent 6786 square miles; Average Annual Precipitation 14-17 inches;

Potential Evapotranspiration 22-23 inches; Average Frost-free Season 115-120 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Williams	40	Typic Argiborolls, fine-loamy, mixed.	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Bowbells	15	Arbiborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well and mod. well drained	60"	High	Moderately slow	Moderate	Moderate	B
Niobell	10	Glossic Natriborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained and mod. well drained	60"	High	Slow	Moderate	Moderate	C
Noonan	5	Typic Natriborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained and mod. well drained	60"	High	Slow	Moderate	Moderate	D
Zahl	5	Entic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B

Table 2.— Soil Characteristics and Interpretations; Soil Association 17

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Wheat units: bu/ac	(2) Barley bu/ac	(3) Oats bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Williams loam 0 to 3 percent slopes	IIc	Low	Medium	29	49	58	2075	Favorable	Moderate-Low strength Shrink-swell	Moderate--Frost action Low strength, Shrink-swell	60	15" - good; 45" - fair; moderate lime
Bowbells loam 0 to 3 percent slopes	IIc	Low	High	33	56	66	2375	Favorable	Moderate-Low strength Shrink-swell	Moderate--Frost action Low strength, Shrink-swell	60	23" - good; 37" - fair; moderate lime
Niobell loam, 0 to 3 percent slopes	IIIs	Low	Medium	26	44	52	1900	Slow permeability	Moderate Low strength Shrink-swell	Moderate--Frost action, Low strength, Shrink-swell	60	19"-good; 41"-fair; moderate lime
Noonan loam, 0 to 3 percent slopes	IVs	Medium	Low	10	17	20	1550	High sodium content	Moderate-Low strength Shrink-swell	Moderate--Frost action Low strength Shrink-swell	6	Good
Zahl loam, 6 to 9 percent slopes	IVe	High	Low	10	17	20	1800	Favorable	Moderate Low strength Shrink-swell	Moderate--Frost action Low strength Shrink-swell	60	20"- good; 40"--fair; clayey

1/ Ratings are given for residences, with basements, that are served by public sewers.

21. Temvik-Williams-Bearpaw association

Level to rolling, well drained, medium textured soils on silt-mantled glacial till uplands

This soil association consists of a broad, nearly level to rolling glacial till plain that has been covered by a thin mantle of silty materials. All or part of the subsoil and the underlying material formed in loamy glacial till. Long, uniform slopes, which extend from smoothly rounded hilltops to well defined branching drainageways are the main landscape features.

Williams and Bearpaw series occupy the convex slopes and smooth midslopes in steeper areas. The Williams soil has a dark grayish-brown loam surface layer about 6 inches thick and a brown and grayish-brown clay loam subsoil. The Bearpaw soil has a dark grayish-brown clay loam surface layer about 6 inches thick and a dark brown and brown clay loam subsoil.

The Temvik series occupies the smooth plane slopes. It has a dark grayish-brown silt loam surface layer about 7 inches thick and a dark grayish-brown and brown silt loam subsoil. The underlying material is light brownish-gray and light olive-gray clay loam.

Minor soils in this association are the Grassna and Zahl soils. The Grassna soils are in swales and shallow drainageways. Zahl soils occupy the tops of knolls, hills, and ridges and steep side slopes of drainageways.

Most of this association is cultivated; the main crops are small grains. Steeper areas are in native grass, and are used for pasture or hayland. Fertility is moderate to high, and the organic matter is moderate. Available water capacity is high. Most farms are cash grain enterprises, although combination feed grain-livestock and cash grain enterprises are common. The main concerns of management are maintaining tilth and fertility and controlling erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 21 . Temvik - Williams - Rearpaw associations: Level to rolling, well drained, medium textured soils on silt mantled glacial till uplands (description)

State South central North Dakota and north central South Dakota ; Extent 369 square miles; Average Annual Precipitation 15-17 inches;

Potential Evapotranspiration 23-24 inches; Average Frost-free Season 120 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Temvik	30	Typic Haploborolls, fine-silty, mixed	Silt loam	Silty mantle overlying glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Williams	20	Typic Argiborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Rearpaw	10	Typic Argiborolls, fine, montmorillonitic	Clay loam	Clay loam glacial till	Well drained	60"	High	Slow	Moderate	High	B
Grassna	5	Pachic Haploborolls, fine-silty, mixed	Silt loam	Silty sediments	Well drained and mod. well drained	60"	High	Moderate	Moderate	Moderate	B
Linton	5	Typic Haploborolls, coarse-silty, mixed	Silt loam	Silty sediments	Well drained	60"	High	Moderate	Moderate	Low	B
Zahl	5	Entic Haploborolls, fine loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B

Table 2.--Soil Characteristics and Interpretations; Soil Association 21

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Morain units: bu/ac	(2) Barley bu/ac	(3) Oats bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Terwik silt	IIc	Low	Medium	29	49	58	2300	Favorable	Moderate--Low strength Shrink-swell	Moderate--Frost action, Low strength, Shrink-swell	60	24" good; 26" fair; moderate lime
Williams loam 3 to 6 percent slopes	IIe	Low	Medium	29	49	58	2100	Favorable	Moderate Low strength Shrink-swell	Moderate--Frost action Low strength Shrink-swell	60	15" good; 15" fair; moderate lime
Sharpaw clay loam, 0 to 3 percent slopes	IIc	Low	Medium	30	51	60	1975	Slow permeability	Severe--Shrink-swell, Low strength	Severe--Shrink-swell, Low strength	60	Fair; clayey and moderate lime
Grassna silt loam, 0 to 3 percent slopes	IIc	Low	High	34	58	68	2475	Favorable	Moderate Low strength, Shrink-swell	Moderate--Frost action	60	40" good; 20" fair; moderate lime
Linton silt loam, 0 to 3 percent slopes	IIe	Low; severe wind erosion	Medium	27	46	54	2275	Favorable	Moderate Low strength, Shrink-swell	Moderate--Frost action	60	29" good; 31" fair; moderate lime
Zahl loam, 6 to 9 percent slopes	IVe	High	Low	10	17	20	1900	Favorable	Moderate Low strength, Shrink-swell	Moderate--Frost Action	60	Fair; moderate lime

1/ Ratings are given for residences, with basements, that are served by public sewers.

22. Tanna-Castner association
Mainly level to rolling, shallow and moderately deep, well drained soils on sandstone and shale upland plains

This association is characterized by both long and broad smooth slopes and areas that are undulating and rolling. A well-defined shallow drainage pattern typifies the area. Slope range is mostly 0 to 16 percent. Soils in this association developed chiefly in materials weathered from sandstone and shale.

The Tanna and Castner soils are representative series. Both of these soils occupy long smooth slopes and undulating and rolling landscapes.

The Tanna series typically has a grayish-brown clay loam surface layer about 6 inches thick. The subsoil is brown and light brownish-gray silty clay and silty clay loam about 21 inches thick. The underlying material is pale brown very channery loam. Soft massive and platy shale, interbedded with hard lenses of sandstone, is at a depth of about 31 inches.

The Castner series typically has a dark grayish-brown and brown sandy loam and very channery loam surface layer about 10 inches thick. The underlying material is pale brown very channery loam. Calcareous sandstone is at a depth of about 16 inches.

This association is primarily used for range. The native vegetation is mostly mid- and shortgrasses. Some areas are used for dryland cultivated crops, principally small grains. The association, as a whole, is well suited for range and, to a much lesser extent, for cultivated crops due to limited soil depth and droughtiness. Small grain crops, hay, and pasture produce well under irrigation. Irrigation is confined to the river valleys and adjacent lands where there is a good source of water. Soils in this association are subject to both wind and water erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 22 . Tanna - Castner association: Mainly level to rolling, shallow and moderately deep, well drained soils on sandstone and shale upland plains. (description)

State South central Montana ; Extent 508 square miles; Average Annual Precipitation 12-16 inches;

Potential Evapotranspiration 25-26 inches; Average Frost-free Season 90-120 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Tanna	25	Aridic Argiborolls; fine, montmorillonitic	Clay loam	Material weathered from interbedded shales, mudstones or sedimentary beds	Well	20 to 40"	Low	Slow	Low*	Moderate	C
Castner	20	Lithic Haploborolls; loamy-skeletal, mixed	Channery loam	Material weathered from sandstone, argillites or quartzites	Well	6 to 20"	Very low	Moderate	Low	Low	C

* If water is available the frost potential will be high.

Table 2.--Soil Characteristics and Interpretations; Soil Association 22

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1)W.Wheat (2)S.Wheat (3)Barley units: bu/ac	bu/ac	bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Tanna clay loam, 4 to 15 percent slopes	IIIe	Medium	Medium	30	25	40	1500	Slow Permeability less than 40 inches to shale; slopes	Moderate-shrink-swell, slope, 20 to 40" to rippable bedrock	Moderate-shrink-swell, slope, 20 to 40" to rippable bedrock	17	Fair: moderately high in clay
Castner channery loam, 8 to 15 percent slopes	VIs	High	Medium	--	--	--	1200	Slope; 6 to 20 inches to bedrock	Severe--6 to 20 inches to hard bedrock	Severe--6 to 20 inches to hard bedrock	10	Poor: high content of coarse fragments

1/ Ratings are given for residences, with basements, that are served by public sewers.

23. Williams-Zahl association

Level to rolling, well drained, medium textured soils on glacial till plains

This soil association consists of a broad undulating to rolling plain, with some nearly level ground moraine, and discontinuous, hilly recessional moraines. Slopes are mostly level to rolling. They are steeper, however, in a few places around potholes and along drainageways.

The Williams series occupies the smooth less sloping parts of the landscape and the midslopes in steeper areas. It has a dark grayish-brown loam surface layer about 6 inches thick and a brown and grayish-brown clay loam subsoil.

The Max series occupies the upper slopes above the Williams soils. It has a dark grayish-brown loam surface layer about 6 inches thick and a brown and light olive-brown loam subsoil that contains free lime at depths of about 12 inches.

The Zahill series occupies the tops of knolls, hills, ridges, and steep sideslopes of drainageways. It has a grayish brown calcareous loam surface layer about 6 inches thick. Beneath this is calcareous, light brownish-gray and olive-gray loam or clay loam glacial till.

Other important soils in this association are the Zahl and Arnegard soils. Zahl soils are in similar positions as the Zahill soils, but have thin dark-colored surface layers. Arnegard soils are in swales and drainageways.

The soils are used as pasture and cropland, depending upon the slope. Slopes in excess of 9 percent are mostly in native grass, and are used for pasture or hayland. Fertility is low to high, and the organic matter content is moderate. Available water capacity is high. Most farms are combination feed grain-livestock and cash grain enterprises. The main concerns of management are controlling erosion and maintaining soil tilth and fertility.

Table 1 . Soil Characteristics and Interpretations

Soil Association 23 . Williams - Zahl association: Level to rolling, well drained, medium textured soils on glacial till plains. (description)

State Central and northwestern North Dakota and northeastern Montana ; Extent 4744 square miles; Average Annual Precipitation 13-17 inches;

Potential Evapotranspiration 23-24 inches; Average Frost-free Season 115-120 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Williams	30	Typic Argiborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Zahl	15	Entic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Zahill	10	Typic Ustorthents, fine-loamy, mixed, (calcareous), frigid	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Max	10	Typic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Bowbells	10	Argiborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well and mod. well drained	60"	High	Moderately slow	Moderate	Moderate	B
Arnegard	5	Pachic Haploborolls, fine-loamy, mixed	Loam	Loamy alluvium	Well drained	60"	High	Moderate	Moderate	Moderate	B

Table 2.--Soil Characteristics and Interpretations; Soil Association 23

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1)Wheat (2)Barley (3)Oats units: bu/ac	bu/ac	bu/ac	b. Native Grazeable Resources pwf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Williams loam 6 to 9 percent slopes	IIIe	Medium	Medium	20	34	40	2075	Favorable	Moderate-Low strength, Shrink-swell	Moderate--Frost action, Shrink-swell, Low strength	60	15" good; 45" fair; moderate lime
Zahl loam, 6 to 9 percent slopes	IVe	High	Low	9	15	18	1800	Favorable	Moderate-Low strength, Shrink-swell	Moderate--Frost action, Shrink-swell, Low strength	60	Fair; moderate lime
Zahill loam, 6 to 9 percent slopes	IVe	High	Low	9	15	18	1800	Favorable	Moderate-Low strength, Shrink-swell	Moderate--Frost action, Shrink-swell, Low strength	60	Fair; moderate lime
Max loam, 6 to 9 percent slopes	IIIe	Medium	Medium	20	34	40	2000	Favorable	Moderate-Low strength, Shrink-swell	Moderate--Frost action, Shrink-swell, Low strength	60	16" good; 44" fair; moderate lime
Bowbells loam 3 to 6 percent slopes	IIe	Medium	High	26	44	52	2275	Favorable	Moderate-Low strength, Shrink-swell	Moderate--Frost action, Shrink-swell, Low strength	60	23" good; 37" fair; moderate lime
Arnegard loam 0 to 3 percent slopes	IIc	Low	High	33	55	66	2550	Bedrock below 60"	Moderate Low strength, Shrink-swell	Moderate--Frost action, Shrink-swell, Low strength	60	32" good; 28" fair; moderate lime

1/ Ratings are given for residences, with basements, that are served by public sewers.

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24. Reeder-Rhoades-Cabba association

Mainly level to rolling, well drained, moderately deep, loamy soils on sandstone and shale

This association of loamy soils is usually nearly level to rolling, but small areas of hilly to steep soils are on the sides of buttes and along streams and entrenched drainageways. The soils formed in materials derived from soft sandstone or shale.

Reeder soils are moderately deep, well drained, and have loam surface layers and slightly hard or hard subsoils of loam or clay loam, underlain by soft sandstone or shale at depths ranging from 20 to 40 inches.

The nearly level to sloping Rhoades soils are moderately well drained, and are in swales and the lower parts of the landscapes. These claypan soils have thin, loamy surface layers and extremely hard subsoils of clay loam or clay. The underlying soft bedrock is at depths of 30 inches or more.

The well drained shallow Cabba soils are in the higher parts of the landscapes on ridges and buttes and in hilly to steep areas along streams and drainageways. They have textures of loam or clay loam underlain by soft sandstone, or at depths of 10 to 20 inches.

Other important soils in the association are Flasher and Twilight soils. The shallow Flasher soils have sandy textures and are on ridgetops. The moderately deep, sandy Twilight soils commonly are in positions below Flasher soils.

Many areas of Reeder soils are in cultivation. Small grain, sorghum, and alfalfa are the main crops. Most areas of the Cabba and Rhoades soils are used for range. The native vegetation is primarily mid- and shortgrasses. Conservation of moisture, maintenance of fertility, and control of erosion and soil blowing are concerns of management. Limitations are moderate or severe for building sites, roads, septic tank disposal fields, and recreation uses. The mixed land use pattern, together with scattered native trees and shrubs along streams and drainageways, provide habitat for antelope, deer, pheasant, and sharp-tailed grouse.

Table 1 . Soil Characteristics and Interpretations

Soil Association 24 . Reeder - Rhoades - Cabba association: Mainly level to rolling, well drained, moderately deep, loamy soils on sandstone and shale. (description)

State NW. South Dakota and SW. North Dakota ; Extent 6234 square miles; Average Annual Precipitation 15-17 inches;

Potential Evapotranspiration 23 to 25 inches; Average Frost-free Season 120-130 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Reeder	25	Typic Argiborolls, fine-loamy, mixed	Loam	Soft sandstone or sandy shale	Well	20-40"	Low and moderate	Moderate	Moderate	Low	B
Rhoades	25	Leptic Natriborolls, fine, montmorillonitic	Loam	Loamy and clayey residuum from soft shales	Moderately well	60"	Low	Very slow	Moderate	High	D
Cabba	10	Typic Ustorthents, Loamy, mixed (calcareous), frigid, shallow	Silt loam	Loamy shales, soft sandstone or siltstone	Well	10-20"	Very low and low	Moderate above bedrock, slow in bedrock	Moderate	Low	B
Flasher	5	Typic Ustipsamments, mixed, frigid, shallow	Loamy fine sand	Soft sandstone	Somewhat excessive	10-20"	Very low	Rapid, slow in bedrock	Low	Low	A
Twilight	10	Borollic Camborthids, coarse-loamy, mixed	Fine sandy loam	Soft sandstone	Well	20-40"	Low	Moderately rapid above bedrock	Low	Low	B

Table 2.--Soil Characteristics and Interpretations; Soil Association 24

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1)Oats (2)S.Wheat (3)Alfalfa units: (Bu)	(Bu)	(Tons)	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Reeder loam, 2 to 6 percent slopes	IIe	Low	Medium	45	26	1.6	2000	Low or moderate AWC, 20 to 40 inches to bedrock	Moderate-rippable bedrock, 20 to 40 inches	Moderate--CL material, Frost action	18-24	Good
Rhoades loam, 2 to 6 percent slopes	VIs	High	Low	--	--	--	1000	Claypan subsoil, very slow permeability, high salts	Severe--high Shrink-swell potential	Severe--high Shrink-swell potential, Low strength	10-16	Poor: clayey high sodium content
Cabba loam, 15 to 40 percent slopes	VIIs	Very high	Low	--	--	--	1400	Not suited; slopes, very low or low AWC	Severe--slope <20 inches to rippable bedrock	Severe--slopes >15 percent	4-7	Fair: low fertility
Flasher loamy fine sand, 6 to 15 percent slopes	VIe	Very high (severe wind erosion hazard)	Low	--	--	--	1700	Very low AWC <20 inches to bedrock	Moderate <20 inches to rippable bedrock	Moderate--<20 inches to bedrock	6-10	Fair: low fertility
Twilight fine sandy loam, 6 to 15 percent slopes	VIe	Very high	Low	--	--	--	1900	20 to 40 inches to bedrock, gently to strongly sloping	Moderate if <15% slopes; Severe if >15% slopes; rippable bedrock	Slight on <8% slopes; moderate if 8 to 15% slopes	10-16	Fair: low fertility

1/ Ratings are given for residences, with basements, that are served by public sewers.

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25. Morton-Reeder-Cabba association

Mainly level to rolling, well drained, moderately deep, loamy soils on shale and sandstone

This association consists of nearly level to rolling uplands. It includes hilly to steep sides of drainageways and steep ridges and buttes that have ledgy outcrops of cemented sandstone or siltstone. Intermittent streams drain the area, and broad swales are between low hills and ridges.

The nearly level to sloping Morton soils have surface layers of silt loam and hard subsoil layers of silty clay loam. The underlying soft silty shale, siltstone, or sandstone is at depths ranging from 20 to 40 inches.

The rolling to steep Cabba soils have surface layers of loam or silt underlain by calcareous loam. Soft silty shale, siltstone, or sandstone occurs at depths ranging from 10 to 20 inches.

Other important soils in the association are of the loamy Reeder, clayey Regent, and sandy Vebar series. They occupy nearly level to sloping positions similar to those of the Morton soil.

This association is used for cropland and range. Small grain, sorghum, and alfalfa are the principal crops in areas of Morton, Reeder, Regent, and Vebar soils. Conservation of moisture, maintenance of fertility, and control of erosion and soil blowing are the main concerns of management. The rolling to steep Cabba soils are used mostly for range. The native vegetation consists of mid- and shortgrasses. Morton soils have moderate limitations for building sites, roads, septic tank disposal fields, and recreation uses, but the rolling to hilly Cabba soils have severe limitations for these uses. The mixed cropland and range pattern of land use and the presence of field and farmstead windbreaks provide habitat for deer, pheasant, and sharp-tailed grouse.

Table 1 . Soil Characteristics and Interpretations

Soil Association 25 . Morton - Reeder - Cabba association: Mainly level to rolling, well drained, moderately deep, loamy soils on shale and sandstone (description)

State NW. South Dakota and SW. North Dakota ; Extent 6298 square miles; Average Annual Precipitation 15-17 inches;

Potential Evapotranspiration 24 inches; Average Frost-free Season 120-130 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Morton	30	Typic Argiborolls, fine-silty, mixed	Silt loam	Soft silty shale, siltstone or sandstone	Well	20-40"	Moderate	Moderate above bedrock, slow in bedrock	Moderate	Low or moderate	B
Reeder	20	Typic Argiborolls, fine-loamy, mixed	Loam	Soft sandstone or sandy shale	Well	20-40"	Low and moderate	Moderate above bedrock, slow in bedrock	Moderate	Low	B
Regent	5	Typic Argiborolls, fine, montmorillonitic	Silty clay loam	Soft shales	Well	20-40"	Low and moderate	Slow	Low	High	C
Cabba	10	Typic Ustorthents, loamy, mixed (calcareous), frigid, shallow	Silt loam	Loamy shales, soft sandstone or siltstone	Well	10-20"	Very low and low	Moderate above bedrock, slow in bedrock	Moderate	Low	B
Vebar	5	Typic Haploborolls, coarse-loamy, mixed	Fine sandy loam	Soft sandstone	Well	20-40"	Low	Moderately rapid above bedrock, slow in bedrock	Moderate	Low	B

Table 2 ...Soil Characteristics and Interpretations; Soil Association 25

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1)Oats (2)S.Wheat(3)Alfalfa units: (Bu)	(Bu)	(Tons)	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Norton silt loam, 2 to 6 percent slopes	IIe	Low	Medium	46	26	1.7	2000	Low and moderate AWC, 20 to 40" to bedrock	Moderate-rippable bedrock, 20 to40", Shrink-swell, Low strength	Moderate--Frost action, Shrink-swell, Low strength	18-24	Good
Reeder loam, 2 to 6 percent slopes	IIe	Low	Medium	45	26	1.6	2100	Low and moderate AWC, 20-40" to bedrock	Moderate-rippable bedrock, 20-40", Low strength	Moderate--Frost action, Shrink swell, Low strength	18-24	Good
Regent silty clay loam, 2 to 9 percent slopes	IIIe	Medium	Medium	38	24	1.5	1800	Low and moderate AWC, 20-40" to bedrock	Severe--high Shrink-swell	Severe--Frost action, high shrink-swell potential, Low strength	18-30	Fair: clayey
Cabba loam, 15 to 40 percent slopes	VIIs	Very high	Low	--	--	--	1400	Not suited; slope, very low or low AWC	Severe--slopes >15%	Severe--slopes >15%	4-7	Fair:low fertility
Vebar fine sandy loam, 0 to 6 percent slopes	III	Medium: wind erosion hazard	Medium	37	24	1.4	2200	Low AWC, 20 to 40" to bedrock	Slight	Moderate--Frost action	20-40	Good: susceptible to soil blowing

1/ Ratings are given for residences, with basements, that are served by public sewers.

26. Williams-Zahill association

Mainly level to rolling, deep, well drained soils on glacial uplands

This association is chiefly characterized by long, broad, smooth slopes that are level to rolling. Well-defined shallow drainage patterns and systems of closed basins typify the area. Slope range is mostly 0 to 16 percent. Soils in this association developed mainly in calcareous glacial till.

The Williams and Zahill soils are representative series in this association. The Williams soils occupy the more level and undulating areas, and the Zahill series are on the rolling areas.

The Williams series typically has a dark grayish-brown loam surface layer about 6 inches thick. The subsoil is about 18 inches thick, and is in three parts: the upper 4 inches is brown clay loam, the next 5 inches is grayish-brown clay loam, and the lower part is light olive-brown, calcareous, light clay loam. The underlying material is light olive-brown and light yellowish-brown calcareous loam.

The Zahill series typically has a grayish-brown, clay loam surface layer about 6 inches thick. The underlying material is light brownish-gray, calcareous clay loam to about 30 inches, and it is olive-gray below.

This association is primarily used for such dryland cultivated crops as small grain. Some areas are used for range. The native vegetation is mid- and shortgrasses. This association, as a whole, is well suited for dryland farming with a crop-fallow management system. Small grains, hay, and pasture produce well under irrigation in the river valleys and adjacent lands where there is a good source of water. Soils in this association are subject to both wind and water erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 26 . Williams - Zahill association: Mainly level to rolling, deep, well drained soils on glacial uplands (description)

State Northeastern Montana ; Extent 6779 square miles; Average Annual Precipitation 10-14 inches;

Potential Evapotranspiration 22-24 inches; Average Frost-free Season 100-125 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Williams	30	Typic Argiborolls; fine-loamy, mixed	Loam	Glacial till	Well	40-60"	Moderate high	Moderate in upper 36 inches; slow below about 36 inches	Moderate*	Moderate	B
Zahill	15	Typic Ustorthents, fine-loamy, mixed (calcareous), frigid	Clay loam	Glacial till	Well	40-60"	Moderate	Moderately slow	Moderate*	Moderate	B

* If water is available the frost potential will be high.

Table 2.- Soil Characteristics and Interpretations; Soil Association 2(

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (Specify crops) (1) Winter Wheat units: bu/ac	(2) Spring Wheat bu/ac	(3) Barley bu/ac	b. Native Grazeable Resources # /acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Williams loam, 0 to 4 percent slopes	IIe	Low	High	22	28	50	1500	Saline seep hazard	Moderate-moderate shrink-swell, low strength	Moderate--moderate shrink-swell, low strength, frost action	60	Good in upper 15", fair below; moderate clay and lime content
Zahill clay loam, 8 to 15 percent slopes	IVe	High	Moderate	20	16	32	1200	Slopes, saline seep hazard	Moderate--slopes, shrink-swell, low strength	Moderate--slopes, frost action, shrink swell	60	Fair: moderate clay and lime content

1/ Ratings are given for residences, with basements, that are served by public sewers.

27. Bearpaw-Zahill association

Mostly level to rolling, deep, well drained soils on glacial till plains

This association is characterized by level to undulating, smooth, long, and broad slopes. A well-defined, shallow drainage pattern typifies the area. Slope range is mostly 0 to 16 percent. Soils in this association developed in materials weathered from calcareous glacial till.

The Bearpaw and Zahill soils are representative series in this association. Bearpaw soils occupy the nearly level and smooth sloping area, and the Zahill soils occupy the tops of low hills, knolls, and ridges in the rolling areas.

The Bearpaw series typically has a dark grayish-brown clay loam surface layer about 6 inches thick. The subsoil is in two parts. The upper 8 inches is dark brown and brown, heavy clay loam, and the lower part is grayish-brown, calcareous clay loam about 6 inches thick. The underlying material is grayish-brown, calcareous clay loam to a depth of 60 inches.

The Zahill series typically has a grayish-brown clay loam surface layer about 6 inches thick. The underlying material is light brownish-gray calcareous clay loam to about 30 inches, and is olive-gray below.

This association is used largely for dryland small grains, range, and irrigated hay. The native vegetation is mid- and shortgrasses. The association is well suited for dryland crops and range. Small grains produce well under a crop-fallow management system. Where there is a source of water, irrigated hay yields are good. Soils in this association are subject to both wind and water erosion.

Table 2- Soil Characteristics and Interpretations; Soil Association 7(

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (Specify crops) (1) Winter Wheat units: bu/ac	(2) Spring Wheat bu/ac	(3) Barley bu/ac	b. Native Grazeable Resources # /acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Williams loam, 0 to 4 percent slopes	IIe	Low	High	22	28	50	1500	Saline seep hazard	Moderate--moderate shrink-swell, low strength	Moderate--moderate shrink-swell, low strength, frost action	60	Good in upper 15", fair below; moderate clay and lime content
Zahill clay loam, 8 to 15 percent slopes	IVe	High	Moderate	20	16	32	1200	Slopes, saline seep hazard	Moderate--slopes, shrink-swell, low strength	Moderate--slopes, frost action, shrink swell	60	Fair: moderate clay and lime content

1/ Ratings are given for residences, with basements, that are served by public sewers.

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27. Bearpaw-Zahill association

Mostly level to rolling, deep, well drained soils on glacial till plains

This association is characterized by level to undulating, smooth, long, and broad slopes. A well-defined, shallow drainage pattern typifies the area. Slope range is mostly 0 to 16 percent. Soils in this association developed in materials weathered from calcareous glacial till.

The Bearpaw and Zahill soils are representative series in this association. Bearpaw soils occupy the nearly level and smooth sloping area, and the Zahill soils occupy the tops of low hills, knolls, and ridges in the rolling areas.

The Bearpaw series typically has a dark grayish-brown clay loam surface layer about 6 inches thick. The subsoil is in two parts. The upper 8 inches is dark brown and brown, heavy clay loam, and the lower part is grayish-brown, calcareous clay loam about 6 inches thick. The underlying material is grayish-brown, calcareous clay loam to a depth of 60 inches.

The Zahill series typically has a grayish-brown clay loam surface layer about 6 inches thick. The underlying material is light brownish-gray calcareous clay loam to about 30 inches, and is olive-gray below.

This association is used largely for dryland small grains, range, and irrigated hay. The native vegetation is mid- and shortgrasses. The association is well suited for dryland crops and range. Small grains produce well under a crop-fallow management system. Where there is a source of water, irrigated hay yields are good. Soils in this association are subject to both wind and water erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 27 . Bearpaw - Zahill associations: Mainly level to rolling, deep, well drained soils on glacial till plains (description)

State Central and eastern Montana and western North Dakota ; Extent 881 square miles; Average Annual Precipitation 10-16 inches;

Potential Evapotranspiration 25-26.5 inches; Average Frost-free Season 110-125 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Bearpaw	30	Typic Argiborolls, fine, montmorillonitic	Clay loam	Glacial till	Well	40-60"	High	Slow	Moderate*	Moderate	B
Zahill	15	Typic Ustorthents, fine-loamy, mixed (calcareous), frigid	Clay loam	Glacial till	Well	40-60"	Moderate	Moderately slow	Moderate*	Moderate	B

* If water is available the frost potential will be high.

Table 3.— Soil Characteristics and Interpretations; Soil Association 27 191<

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Winter Wheat (2) Spring Wheat (3) Barley units: bu/ac	bu/ac	bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Bearpaw clay loam, 0 to 4 percent slopes	IIe	Low	High	40	35	50	2000	Slow permeability 2/	Moderate moderate shrink-swell, low strength,	Moderate--moderate shrink-swell, frost action, low strength	60	Fair: moderate clay and lime content
Zahill clay loam, 8 to 15 percent slopes	IVe	High	Moderate	20	16	32	1200	Slope: 2/	Moderate-slope, shrink-swell, low strength	Moderate--slope, shrink-swell, frost action	60	Fair: moderate clay and lime content

1/ Ratings are given for residences, with basements, that are served by public sewers. 2/ Potential saline-seep hazard.

29. Judith-Musselshell association

Level to rolling, deep, well drained soils on uplands of old alluvium

This association is characterized by long and broad, smooth fans and terraces. Undulating to rolling areas are typically near the base of adjacent mountains. Slope range is mostly 0 to 16 percent. Soils in this association developed in old alluvium high in calcium carbonate.

The Judith and Musselshell soils are representative series in this association. Judith soils occupy terraces and fans near the mountains, and Musselshell soils occupy terraces away from the mountains in a drier moisture regime.

The Judith series typically has a dark grayish-brown and light brownish-gray clay loam surface layer about 10 inches thick. The underlying material is light gray and white, and is in three parts. The upper 16 inches is clay loam, the middle 18 inches is very gravelly loam, and the lower part, to about 60 inches, is very gravelly sandy loam. The profile is calcareous throughout.

The Musselshell series typically has a dark grayish-brown loam surface layer about 3 inches thick. The underlying material is pale brown and very pale brown, and is in three parts. The upper 10-inch depth is clay loam, the middle 16-inch layer is loam, and the lower part, to a depth of about 60 inches, is very gravelly fine sandy loam. The profile is calcareous throughout.

This association is principally used for range. The native vegetation is mostly mid- and shortgrasses. Some areas are used for dryland cultivated crops, largely small grains. The association, as a whole, is suited for range and dryland grain. The main enterprise is cattle. Soils in this association respond well to irrigation. The chief irrigated crops are small grain, hay, and pasture.

Table 1 . Soil Characteristics and Interpretations

Soil Association 29 . Judith - Musselshell association: Mainly level to rolling, deep, well drained soils; on uplands of old alluvium (description)

State Central and west central Montana ; Extent 704 square miles; Average Annual Precipitation 10-15 inches;

Potential Evapotranspiration 25 inches; Average Frost-free Season 90-120 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Root-ing Zone	8 Avail-able Water Capac-ity	9 Perme-ability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydro-logic Soil Group
Judith	30	Typic Calci-borolls; fine-loamy, carbonatic	Clay loam	High lime alluvium	Well	40-60"	Low	Moderate	Moderate	Low	B
Musselshell	10	Borollic Calci-orthids; coarse-loamy, carbonatic	Loam	High lime alluvium over gravelly sandy loam	Well	40-60"	Low	Moderate	Moderate	Low	B

Table 2 --Soil Characteristics and Interpretations; Soil Association 29

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Winter wheat (2) Spring wheat (3) Barley units: bu/ac	bu/ac	bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Judith clay loam, 4 to 8 percent slopes	IIIe	Moderate	Medium to High	30	22	36	2000	Low available water high lime content	Slight	Moderate--Frost action, low strength	7	Poor: high in carbonates and high in coarse fragments below 20 inches
Musselshell loam, 0 to 4 percent slopes	IIIe	Moderate	Medium	22	20	30	1100	Low available water	Slight	Moderate--Frost action	7	Poor: high in carbonates; also high content of coarse fragments below 30 inches

1/ Ratings are given for residences, with basements, that are served by public sewers.

30. Vebar-Morton-Flasher association

Level to rolling, well drained and excessively drained, mainly moderately coarse and coarse textured soils on sandstone uplands

This soil association consists of nearly level to rolling uplands. It also includes strongly dissected slopes adjacent to stream valleys and isolated areas of steep hills, buttes, and angular ridges with outcrops of cemented, ledge-like sandstone. The less sloping areas have long, uniform slopes. Surface drainage is fully developed. Numerous intermittent streams drain the area, and broad swales extend into the upland between the low hills and ridges.

The Vebar series occupies long, plane, and slightly convex slopes and broad convex crests of hills and ridges. It has a dark grayish-brown fine sandy loam surface layer about 5 inches thick and a dark grayish-brown and brown fine sandy loam subsoil. This grades into soft, massive calcareous sandstone at a depth of about 32 inches.

The Morton series occupies gentle convex ridgetops and the plane and slightly convex side slopes of the hills and ridges. It has a dark grayish-brown silt loam surface layer about 5 inches thick and a dark grayish-brown and brown silty clay loam subsoil. This grades into platy soft siltstone and shale at a depth of about 35 inches.

The Flasher series occupies the sharply convex crests of ridges and hills and the tops and steep side slopes of high sandstone-capped hills. It has a dark grayish-brown loamy fine sand surface layer about 6 inches thick. This is underlain by light olive-brown loamy fine sand which grades to calcareous soft sandstone at a depth of about 10 inches.

Other important soils in this association are the Rhoades, Parshall, and Lihen soils. Rhoades and Parshall soils are found in swales and toe-slope positions. Lihen soils occur on wind-modified topography that ranges from nearly level to rolling and hummocky. Areas in which the Vebar and Morton soils dominate are used mostly as cropland. The shallow Flasher soils are usually in native grass. Fertility and organic matter content is moderate to high on the Vebar and Morton soils. It is low on the Flasher soils. Available water capacity ranges from low to high. Most farms are grain and livestock enterprises. The main concerns of management are controlling soil blowing, both in cropland and rangeland areas.

Table 1 . Soil Characteristics and Interpretations

Soil Association 30 . Vebar - Morton - Flasher association: Level to rolling, well drained and excessively drained, mainly moderately coarse and coarse textured soils on sandstone uplands (description)

State Southwestern North Dakota and northwestern South Dakota ; Extent 3273 square miles; Average Annual Precipitation 15-17 inches;

Potential Evapotranspiration 23-24 inches; Average Frost-free Season 120-125 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Vebar	25	Typic Haploborolls, coarse-loamy, mixed	Fine sandy loam	Soft sandstone	Well drained	30-40"	Moderate	Moderately rapid*	Moderate	Low	B
Morton	15	Typic Argiborolls, fine-silty, mixed	Silt loam	Interbedded silty shales and siltstone	Well drained	30-40"	Moderate	Moderate*	Moderate	Moderate	B
Rhoades	15	Leptic Natriborolls, fine, montmorillonitic, frigid	Loam	Stratified loamy and clayey sediments	Moderately well drained	40-60"	Low	Very slow	Low	High	D
Flasher	5	Typic Ustipsamments, mixed, frigid, shallow	Loamy fine sand	Soft sandstone	Somewhat excessively drained	5-10"	Very low	Moderately rapid & rapid*	Low	Low	A
Parshall	5	Pachic Haploborolls, coarse-loamy, mixed	Fine sandy loam	Fine sandy loam alluvium	Well drained	60"	Moderate	Moderately rapid	Moderate	Low	B
Lihen	5	Eptic Haploborolls, sandy, mixed	Loamy fine sand	Sandy sediments	Well drained	60"	Low	Rapid	Low	Low	A

*Permeability only for material above soft bedrock.

Table 2.--Soil Characteristics and Interpretations; Soil Association 30

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Spring wheat units: bu/ac	(2) Barley bu/ac	(3) Oats bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Vebar fine sandy loam, 6 to 9 percent slopes	IVe	High; severe wind erosion	Medium	16	28	33	1900	Bedrock at 32"	Slight	Moderate--Frost action, low strength	32	Good
Morton silt loam, 3 to 6 percent slopes	IIe	Medium	Medium	24	41	48	1850	Bedrock at 35"	Moderate--Frost action, low strength	Moderate--Frost action, low strength	26	Good
Rhoades loam, 3 to 6 percent slopes	VIs	Medium	Low	--	--	--	675	High sodium content	Severe--Shrink-swell, low strength	Severe--Shrink-swell, low strength	4	Good
Flasher loamy fine sand, 9 to 15 percent slopes	VIe	High; severe wind erosion	Low	--	--	--	1150	Bedrock to 10"	Moderate--Slope	Moderate--Slope	10	Fair; sandy
Parshall fine sandy loam, 0 to 3 percent slopes	IIIe	Medium	Medium	22	37	44	2150	Favorable	Slight	Moderate--Frost action, low strength	60	37" good; 23" fair; moderate lime
Lihen loamy fine sand, 3 to 6 percent slopes	IVe	High; severe wind erosion	Low	12	20	24	2200	Low available water capacity	Slight	Slight	60	Fair; sandy and moderate lime

1/ Ratings are given for residences, with basements, that are served by public sewers.

31. Ringling-Cabba-Fergus association

Mainly undulating to hilly, shallow to deep, well drained soils; on shaley uplands

This association is characterized by rough hilly land interspersed by fans, terraces, and bottom lands in narrow valleys. Slopes are about 3 to 30 percent, with 0 to 3 percent slopes in valley bottoms. Soils in this association developed in material weathered from sedimentary rock. Soils in the valleys developed in alluvium.

The Ringling, Cabba, and Fergus soils are representative series in this association. Ringling soils occupy narrow ridges and steep side slopes of hills. Cabba soils occupy broad hilltops and valley side slopes. Fergus soils occupy bottom lands, low terraces, and fans in valleys.

The Ringling series typically has a reddish-brown, channery loam surface layer about 3 inches thick. The underlying material is reddish-brown, very channery loam, about 10 inches thick. Hard, platy, red, baked shale is at about 13 inches.

The Cabba series typically has a grayish-brown, cobbly clay loam surface layer about 2 inches thick. The subsoil is grayish-brown, gravelly clay loam, about 5 inches thick. The underlying material is very pale brown gravelly loam about 11 inches thick. Soft sedimentary bedrock is at about 18 inches.

The Fergus series typically has a brown and dark grayish-brown surface layer about 9 inches thick. The upper 4 inches is clay loam, and the lower part is silty clay loam. The subsoil is reddish-gray

and reddish-brown clay loam and silty clay loam. The underlying material, to a depth of more than 60 inches, is reddish-brown clay loam.

This association is used primarily for range. The native vegetation is mostly mid- and shortgrasses. Some upland areas are used for dryland grain, but production is low. Soils in the valleys are well suited for grain, hay, and pasture. They respond well to irrigation.

Table 1 . Soil Characteristics and Interpretations

Soil Association 31 . Ringling - Cabba - Fergus association: Mainly undulating to hilly, shallow to deep, well drained soils; on shaly uplands (description)

State Southeastern Montana ; Extent 3569 square miles; Average Annual Precipitation 10-15 inches;

Potential Evapotranspiration 25 inches; Average Frost-free Season 100-120 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Ringling	20	Typic Haploboroll, fragmental, mixed	Channery loam	Baked shale and porcellanite beds	Well	5-20"	Very low	Rapid	Low	Low	C
Cabba	15	Typic Ustorthents, loamy, mixed (calcareous), frigid, shallow	Cobbly clay loam	Sedimentary beds	Well	10-20"	Low	Moderate	Moderate*	Low	C
Fergus	10	Typic Argiborolls, fine, mixed	Clay loam	Alluvium	Well	40-60"	High	Moderately slow	Moderate*	Moderate	B

* If water is available, frost potential will be high.

Table 2[illegible]--Soil Characteristics and Interpretations; Soil Association 31

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Winter Wheat (2) Spring Wheat (3) Barley units: bu/ac	bu/ac	bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Ringling channery loam, 15 to 30 percent slopes	VIe	Very high	Low	--	--	--	400	Slopes; rapid permeability	Severe--Slopes over 15 percent	Severe--Slopes over 15 percent	13	Poor: high content of coarse fragments
Cabba cobbly clay loam, 15 to 50 percent slopes	VIIe	Very high	Low	--	--	--	900	Slopes	Severe--Slopes over 15 percent	Severe--Slopes over 15 percent	18 2/	Food to fair depending on clay content and coarse fragments; lime content
Fergus clay loam, 2 to 8 percent slopes	IIIe	Medium	High	28	24	35	1600	Favorable	Moderate--moderate shrink-swell, low strength	Moderate--moderate shrink-swell, frost action, low strength	60	Fair: moderate clay content

1/ Ratings are given for residences, with basements, that are served by public sewers.

2/ In places the sedimentary beds are soft, silty, or loamy; thus would make good cover material to more than 60[illegible]

32. Williams-Zahl-Barnes association

Undulating to hilly, well drained, medium textured soils on glacial till uplands

This association is undulating to hilly, with numerous knolls, hills, ridges, and depressions. Surface drainage is undeveloped. Runoff from the hills flows into the depressions. Slopes are usually short and irregular, with more than 20 percent of the area hilly or steeper.

The Barnes series occurs on the gentle convex crests of the broad hills and ridges and on the plane side slopes. It has a very dark gray loam surface layer about 6 inches thick and a brown loam subsoil. The underlying material is light yellowish-brown loam glacial till.

The Buse and Zahl series occur on the convex crests and steeper side slopes of the hills, ridges, and knolls. They have very dark gray loam surface layers about 7 inches thick, underlain by calcareous, light yellowish-brown loam.

The Williams series occupies the smooth, less sloping parts of the landscape and the midslopes in steeper areas. It has a dark grayish-brown loam surface layer about 6 inches thick and a brown and grayish-brown clay loam subsoil.

Other important soils in this association are the moderately well drained Bowbells soils in swales and the poorly drained Tonka soils in shallow depressions.

The dominant land use is pasture. Local areas of Barnes or Williams soils are used for cropland. Fertility is low to high, and the organic matter content is moderate to high. Available water capacity is high.

Most farms are livestock enterprises with feed grains and hay produced on smooth, less sloping areas. Moderate susceptibility to water erosion is a hazard on cultivated areas. Steep areas are also susceptible to water erosion when heavily overgrazed.

Table 1 . Soil Characteristics and Interpretations

Soil Association 32 . Williams - Zahl - Barnes association: Undulating to hilly, well drained, medium textured soils on glacial till uplands (description)

State Central and north central North Dakota ; Extent 2296 square miles; Average Annual Precipitation 14-17 inches;

Potential Evapotranspiration 22-23 inches; Average Frost-free Season 115 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Williams	30	Typic Argiborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Zahl	20	Entic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Bowbells	10	Argiborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well and mod. well drained	60"	High	Moderately slow	Moderate	Moderate	B
Barnes	10	Udic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Buse	5	Udorthentic Haploborolls, fine-loamy, mixed	Loam	Loamy glacial till	Well drained	60"	High	Moderately slow	Moderate	Moderate	B
Tonka	5	Argiaquic Argialbolls, fine, montmorillonitic, frigid	Silt loam	Loamy alluvium and loamy glacial till	Poorly drained	60"	High	Slow	High	High	C

Table 2 — Soil Characteristics and Interpretations; Soil Association 32 205<

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Spring Wheat units: bu/ac	(2) Barley bu/ac	(3) Oats bu/ac	b. Native Grazeable sources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Williams loam 6 to 9 percent slopes	IIIe	Medium	Medium	20	34	40	2075	Favorable	Moderate--Low strength Frost action	Moderate--Frost action, Low strength, Shrink-swell	60	15"good; 45" fair; moderate lime
Zahl loam, 9 to 15 percent slopes	VIe	Very high	Low	--	--	--	1800	Favorable	Moderate--Low strength Frost action	Moderate--Frost action, Low strength, Shrink-swell	60	Fair; moderate lime
Bowbells loam 3 to 7 percent slopes	IIe	Low	High	30	50	60	2275	Favorable	Moderate--Low strength Frost action	Moderate--Frost action, Low strength, Shrink-swell	60	23" good; 37" fair; moderate lime
Barnes loam, 6 to 9 percent slopes	IIIe	Medium	Medium	23	37	47	2500	Favorable	Moderate--Low strength Frost action	Moderate--Frost action, Low strength, Shrink-swell	60	18" good; 32" fair; moderate lime
Buse loam, 9 to 15 percent slopes	VIe	Very high	Low	--	--	--	2150	Favorable	Moderate--Low strength Frost action	Moderate--Frost action Low strength Shrink swell	60	Fair; moderate lime
Tonka silt loam, 0 to 2 percent slopes	IIw	Low	High	30*	48*	63*	3300	Poorly drained	Severe--Shrink-swell, Wet, Low strength	Severe--Wet, Frost action, Shrink-swell	60	20" good; 40" fair; clayey

1/ Ratings are given for residences, with basements, that are served by public sewers. * Yields given for drained areas.

33. Shambo-Lambert-Cherry association

Mainly undulating and hilly, deep, well drained soils on soft silty uplands

This association is characterized by both long and broad smooth slopes and areas that are undulating to hilly. A well-defined, shallow drainage pattern typifies the area. Slope range is mostly 3 to 30 percent. Soils in this association developed chiefly in materials weathered from soft silty shales.

The Shambo, Lambert, and Cherry soils are representative series in this association. The Shambo and Cherry soils occupy fans and terraces. The Lambert soils occupy fans, terraces, and hills.

The Shambo series typically has a dark grayish-brown loam surface layer about 5 inches thick. The subsoil, about 17 inches thick, is grayish-brown loam in the upper 14 inches and light brownish-gray, calcareous loam in the lower 3 inches. The underlying material is light yellowish-brown and light olive-brown calcareous loam to about 24 inches, and light brownish-gray calcareous gravelly sandy loam to a depth of 60 inches.

The Lambert series typically has a grayish-brown silt loam surface layer about 5 inches thick. The underlying material is in two parts. The upper 31 inches is light brownish-gray and light olive-gray calcareous silt loam, and the lower part is light olive-gray, very fine, sandy loam to a depth of 60 inches.

The Cherry series typically has a grayish-brown silty clay loam surface layer about 3 inches thick. The subsoil is grayish-brown, calcareous silty clay loam about 30 inches thick. The underlying material is light olive-gray, calcareous silty clay to a depth of 60 inches.

This association is used for dryland crops and range. The native vegetation is mostly mid- and shortgrasses. The dryland crops are small grains and hay. The association, as a whole, is well suited for both cropland and range. Soils in this association are subject to wind and water erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 33 . Shambo - Lambert - Cherry association: Mainly undulating and hilly, deep, well drained soils on soft silty shale uplands (description)

State Eastern Montana and western North Dakota ; Extent 2097 square miles; Average Annual Precipitation 10-16 inches;

Potential Evapotranspiration 23-25 inches; Average Frost-free Season 100-125 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Shambo	25	Typic Haploborolls, fine-loamy, mixed	Loam	Loamy alluvium	Well	40-60"	High	Moderate	Moderate*	Low	B
Lambert	20	Typic Ustorthents, fine-silty, mixed (calcareous), frigid	Silt loam	Silty sedimentary material	Well	40-60"	High	Moderately slow	Moderate*	Low	B
Cherry	15	Typic Ustochrepts, fine-silty, mixed frigid	Silty clay loam	Silty clay sediments	Well	40-60"	High	Moderate in upper 33 inches; slow below	Moderate*	Moderate	B

* If water is available, the frost potential is high.

Table 2.--Soil Characteristics and Interpretations; Soil Association 33

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (High management) a. Dryland (specify crops) (1) Winter wheat units: bu/ac	(2) Spring wheat bu/ac	(3) Barley bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Lands (1) Inches available	(2) Suitability
Shambo loam, 2 to 4 percent slopes	IIe	Low	High	25	20	39	1500	Slope	Moderate-moderate frost action	Slight	60	Good upper 19 "; fair below; moderate lime content
Lambert silt loam, 8 to 15 percent slopes	IVe	High	Medium	15	--	20	1000	Slope; moderately slow permeability	Moderate-8 to 15 percent slopes; moderate frost action	Moderate--8 to 15 percent slopes	60	Fair to good; low to moderate lime content
Cherry silty clay loam, 4 to 8 percent slopes	IIIe	Medium	High	22	20	40	1500	Slope; moderately slow permeability	Moderate-moderate shrink-swell, moderate frost action, low strength	Moderate--moderate shrink-swell, low strength, frost action	60	Fair upper 33": moderate clay content; poor below 33": high clay content

1/ Ratings are given for residences, with basements, that are served by public sewers.

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34. Lambert-Williams association

Mainly undulating to hilly, deep, well drained soils on glacial uplands, sedimentary plains, and loamy terraces and fans

This association is characterized by long, broad, smooth slopes and short, irregular slopes that are undulating to hilly. A well-defined drainage pattern typifies the area. Slope range is mostly 3 to 30 percent. Soils in this association are developed in material weathered from loamy sedimentary deposits, glacial till, and loamy material on fans and terraces.

The Lambert and Williams soils are representative series in this association. The Lambert soils are on the steeper, hilly sedimentary plains and terraces and fans. The Williams soils are on the broad, smooth slopes on the glacial uplands.

The Lambert series typically has a grayish-brown silt loam surface layer about 5 inches thick. The underlying material is light brownish-gray silt loam to a depth of about 22 inches, and below this depth it is light olive-gray, calcareous, stratified silt loam, fine sandy loam, and silt clay loam.

The Williams series typically has a dark grayish-brown loam surface layer about 6 inches thick. The subsoil is about 18 inches thick, and is in three parts. The upper 4 inch-depth is brown clay loam. The next 5-inch depth is grayish-brown clay loam, and the lower part is light olive-brown, calcareous light clay loam. The underlying material is light olive-brown and light yellowish-brown, calcareous loam.

Most of this association is used for range, but the less sloping areas are used for such dryland cultivated crops as small grain. The native vegetation is mostly mid- and shortgrasses. This association, as a whole, is well suited for range and, to a lesser extent, for cultivated crops due to the hilly topography. Small grains, hay, and pasture produce well under irrigation. Irrigation is confined largely to the stream valleys and adjacent lands where there is a good source of water. Soils in this association are subject to both wind and water erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 34 . Lambert - Williams association: Mainly undulating to hilly, deep, well drained soils on glacial uplands, sedimentary plains and loamy terraces and fans (description)

State Northeastern Montana ; Extent 991 square miles; Average Annual Precipitation 10-14 inches;

Potential Evapotranspiration 24-25 inches; Average Frost-free Season 100-125 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Lambert	30	Typic Ustorthents, fine-silty, mixed (calcareous), frigid	Silt loam	Silty sedimentary material	Well	40-60"	High	Moderate	Moderate*	Low	B
Williams	20	Typic Argiborolls, fine-loamy, mixed	Loam	Glacial till	Well	40-60"	Moderate and high	Moderate in upper part, slow below 36 inches	Moderate*	Moderate	B

* If water is available, the frost potential is high.

Table 3.--Soil Characteristics and Interpretations; Soil Association 34 211<

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Winter wheat (2) Spring wheat (3) Barley units: bu/ac	bu/ac	bu/ac	b. Native Grazeable Resources lb/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Lambert silt loam, 15 to 30 percent slopes	VIe	Very High	Medium	--	--	--	1000	Not applicable	Severe--slopes over 15 percent	Severe--slopes over 15 percent	60	Fair to good; low to moderate lime content; slopes
Williams loam, 4 to 8 percent slopes	IIIe	Medium	High	30	23	39	1500	Slopes 2/; moderately slow permeability	Moderate--moderate shrink-swell, low strength	Moderate--moderate shrink-swell, frost action, low strength	60	Good in upper 15"; fair below; moderate clay content

1/ Ratings are given for residences, with basements, that are served by public sewers. 2/ Potential seep-saline hazard.

35. Cabba-Morton association

Undulating to steep, shallow and moderately deep, well drained, medium textured soils on siltstone and shale uplands

This soil association is dominantly hilly and steep, interspersed with local, nearly level to undulating areas. Numerous deeply entrenched, intermittent streams drain the area. Occasional outcrops of sedimentary rock and small barren areas are on the steepest slopes. Barren areas with exposures of the sedimentary beds are common on the steep-sided, deeply entrenched coulees near the Missouri River Valley.

The Cabba series occurs on the convex crests and the steep side slopes of hills, ridges, and stream valleys. It has a grayish-brown loam surface layer about 7 inches thick. This is underlain by very pale brown, calcareous loam that grades to soft siltstone and shale at a depth of about 18 inches.

The Morton series occupies the gentler plane and convex slopes. It has a dark grayish-brown silt loam surface layer about 5 inches thick and a dark grayish-brown and brown silty clay loam subsoil. This grades into platy, soft siltstone and shale at a depth of about 35 inches.

Other important soils in this association are the Rhoades, Farland, Flasher, and Vebar soils. Rhoades soils occupy swales and toe-slope positions. The deep, medium textured Farland soils are on nearly level stream terraces. The shallow, coarse textured Flasher soils are on hilly to strongly rolling areas and sandstone-capped ridges. The moderately deep, moderately coarse textured Vebar soils are on smooth, less sloping areas.

This association is used for pasture and cropland. The hilly and steep areas are in native grass. The more extensive areas of Morton, Vebar, and Farland are cultivated.

Ranching is the dominant enterprise, although grain-livestock enterprises do occur. The main concerns of management are controlling water erosion and soil blowing.

Table 1 . Soil Characteristics and Interpretations

Soil Association 35 . Cabba - Morton association: Undulating to steep, shallow and moderately deep, well drained, medium textured soils on siltstone and shale uplands (description)

State Southwestern North Dakota, northeastern Montana, and northwestern South Dakota ; Extent 9702 square miles; Average Annual Precipitation 14-16 inches;

Potential Evapotranspiration 23-24 inches; Average Frost-free Season 115 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Cabba	20	Typic Ustorthents, loamy, mixed, (calcareous), frigid, shallow	Loam	Interbedded siltstones, sandstone, and shale	Well drained	10-20"	Very low	Moderate*	Moderate	Low	B
Morton	15	Typic Argiborolls, fine-silty, mixed	Silt loam	Interbedded silty shales and siltstone	Well drained	30-40"	Moderate	Moderate*	Moderate	Moderate	B
Rhoades	10	Leptic Natriborolls, fine, montmorillonitic, frigid	Loam	Stratified loamy and clayey sediments	Moderately well drained	40-60"	Low	Very slow	Low	High	D
Vebar	10	Typic Haploborolls, coarse-loamy, mixed	Fine sandy loam	Soft sandstone	Well drained	30-40"	Moderate	Moderately rapid*	Moderate	Low	B
Flasher	5	Typic Ustipsamments, mixed, frigid, shallow	Loamy fine sand	Soft sandstone	Somewhat excessively drained	10-20"	Very low	Moderately rapid and rapid	Low	Low	A
Farland	5	Typic Argiborolls, fine-silty, mixed	Silt loam	Stratified loamy alluvium	Well drained	60"	High	Moderate	Moderate	Moderate	B

* Permeability only for material above soft bedrock.

Table 3.--Soil Characteristics and Interpretations; Soil Association 35

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Spring Wheat units: bu/ac	(2) Barley bu/ac	(3) Oats bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Cabba loam, 15 to 35 percent slopes	VIe	Very high	Low	--	--	--	1425	Bedrock at 18" slope	Severe--Slope	Severe--Slope	18	Fair; moderate lime
Morton silt loam, 6 to 9 percent slopes	IIIe	Medium	Medium	19	32	38	1850	Bedrock at 35"	Moderate--Low strength, frost action	Moderate--Frost action, Low strength	35	Good
Rhoades loam, 3 to 9 percent slopes	VIs	Medium	Low	--	--	--	675	High sodium content	Severe--Shrink-swell, low strength	Severe--Shrink-swell, low strength	4	Good
Vebar fine sandy loam, 6 to 9 percent slopes	IVe	High; severe wind erosion	Medium	16	27	32	1900	Bedrock at 32"	Slight	Moderate--Frost action, low strength	32	Good
Flasher loamy fine sand, 15 to 35 percent slopes	VIe	Very high	Low	--	--	--	1150	Bedrock at 10"	Severe--Slope	Severe--Slope	10	Fair; sandy
Farland silt loam, 0 to 3 percent slopes	IIc	Low	Medium	27	46	54	2000	Favorable	Moderate--Shrink-swell, Low strength	Moderate--Frost action, low strength, shrink-swell	60	25" good; 35" fair; moderate lime

1/ Ratings are given for residences, with basements, that are served by public sewers.

38. Scobey-Phillips-Elloam association

Mainly level and undulating, deep, well drained soils on glacial uplands

This association is characterized by broad level areas and undulating broad smooth slopes. Well-defined shallow drainage patterns and some closed basins typify the area. Slope range is mostly 0 to 8 percent. Soils in this association developed in calcareous glacial till.

The Scobey, Phillips, and Elloam soils are representative series in this association. Scobey and Phillips soils occupy the undulating broad smooth slopes, and the Elloam soils are in low basins and swales.

The Scobey series typically has a dark brown clay loam surface layer about 6 inches thick. The subsoil is about 13 inches thick, and is in two main parts. The upper 6-inch part is brown clay, and the lower part is grayish-brown, calcareous heavy clay loam. The underlying material, to a depth of about 60 inches, is calcareous clay loam that is light brownish-gray in the upper 23 inches and grayish-brown below.

The Phillips series typically has a brown loam surface layer about 2 inches thick and a pale brown and light brownish-gray loam subsurface about 5 inches thick. The subsoil is about 15 inches thick, and is in three parts. The upper 3-inch part is brown clay, the next 5-inch part is pale brown, heavy clay loam, and the lower part is grayish-brown, calcareous clay loam. The underlying material, to a depth of about 60 inches, is grayish-brown clay loam.

The Elloam series typically has a light gray surface layer about 2 inches thick. The subsoil is about 30 inches thick, and is in

three main parts. The upper 5-inch depth is brown, light clay, or heavy clay loam. The next 5-inch depth is light olive brown calcareous clay loam, and the lower part is grayish-brown, calcareous clay loam. The underlying material, to a depth of about 60 inches, is grayish-brown, calcareous clay loam.

This association is used for dryland cultivated crops, principally, small grains. Some areas are used for range. The native vegetation is mid- and shortgrasses. This association, as a whole, is well suited for dryland farming with a crop-fallow management system. Soils in this association are subject to both wind and water erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 38 . Scobey - Phillips - Elloam association: Mainly level and undulating, deep, well drained soils on glacial uplands (description)

State Northeastern Montana ; Extent 2312 square miles; Average Annual Precipitation 10-14 inches;

Potential Evapotranspiration 25 inches; Average Frost-free Season 115-125 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Scobey	25	Aridic Argiborolls fine, montmorillonitic	Clay loam	Glacial till	Well	40-60"	Moderate and high	Slow	Low*	Moderate	B
Phillips	25	Borollic Paleargids; fine, montmorillonitic	Loam	Glacial till	Well	40-60"	Moderate and high	Slow	Low*	Moderate	C
Elloam	10	Borollic Natrargids; fine, montmorillonitic	Loam	Glacial till	Well	20-40"	Moderate	Very slow	Low*	Moderate	D

*If water is available the frost potential is moderate.

Table 2.--Soil Characteristics and Interpretations; Soil Association 38

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Winter wheat units: bu/ac	(2) Spring wheat bu/ac	(3) Barley bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Scobey clay loam, 2 to 8 percent slopes	IIIe	Medium	Medium or high	30	28	40	1200	Slopes; slow permeability	Moderate-moderate shrink-swell, low strength	Moderate--moderate shrink-swell, low strength	19	Good or fair; moderate clay content to 19"; Fair to poor below; moderate alkalinity
Phillips loam, 0 to 4 percent slopes	IIIe	Medium	Medium or high	25	23	35	1200	Slow permeability	Moderate-moderate shrink-swell, low strength	Moderate--moderate shrink-swell, low strength	15	Good to fair; moderate clay content to 15"; fair or poor below: moderate alkalinity
Elloam loam, 0 to 2 percent slopes	IVs	Low	Low	--	--	--	600	Saline and alkaline; very slow permeability	Moderate-moderate shrink-swell, low strength	Moderate--moderate shrink-swell, low strength	2	Poor: high salinity and alkalinity and moderately high clay content

1/ Ratings are given for residences, with basements, that are served by public sewers.

41. Thebo-Lisam association

Mainly undulating to steep, moderately deep and shallow, well drained and excessively drained soils on clay shale uplands

This association is characterized by rough complex slopes that are undulating to steep. A well-defined, deep drainage pattern typifies the area. Slope range is mostly 3 to more than 30 percent. Soils in this association developed in materials weathered from clayey shales.

The Thebo and Lisam soils are representative series in this association. Thebo soils occupy undulating and rolling uplands, and Lisam soils occupy the steep, rough areas along deep drainageways.

The Thebo series typically has a light olive-gray, clay surface layer about 9 inches thick. The underlying material, to a depth of about 30 inches, is light olive-gray clay. The material below 30 inches is clay shale.

The Lisam series typically has a grayish-brown surface layer about 3 inches thick. The underlying material, to a depth of about 15 inches, is light brownish-gray and light olive-gray clay. The material below 15 inches is clay shale.

This association is used largely for range. The native vegetation is mid- and shortgrasses. Some areas are used for such dryland cultivated crops as small grains. This association is well suited to range and, to a lesser extent, for cultivated crops due to limited soil depth and droughtiness. Soils in this association are subject to wind and water erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 41 . Thebo - Lisam association: Mainly undulating to steep, moderately deep and shallow, well drained and excessively drained soils on clay shale uplands (description)

State Central and north central Montana ; Extent 3756 square miles; Average Annual Precipitation 10-16 inches;

Potential Evapotranspiration 24-26 inches; Average Frost-free Season 100-125 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Thebo	25	Ustertic Torriorthents; very fine, montmorillonitic (calcareous), frigid	Clay	Clay mudstone	Well	20-40"	Low	Very slow	Low*	High	D
Lisam	15	Ustic Torriorthents; clayey, montmorillonitic (nonacid), frigid, shallow	Clay	Clay mudstone or shale	Well	10-20"	Very low	Very slow	Low*	High	D

*If water is available the frost potential is moderate.

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Table 2.--Soil Characteristics and Interpretations; Soil Association 41 221<

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Winter Wheat units: bu/ac	(2) Spring Wheat bu/ac	(3) Barley bu/ac	b. Native Grazeable sources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Thebo clay, 3 to 8 percent slopes	IVe	High	Low or medium	25	20	35	2,000	Clay texture--very slow permeability	Severe--high shrink-swell, low strength	Severe--high shrink-swell, low strength	20 to 40"	Poor: high in clay
Lisam clay, 8 to 25 percent slopes	VIe	High	Low	--	--	--	300	Clay texture--very slow permeability	Severe--high shrink-swell, low strength, slope	Severe--high shrink-swell, low strength, slope	10 to 20"	Poor: high in clay

1/ Ratings are given for residences, with basements, that are served by public sewers.

42. Pendroy-Scobey association

Mainly level to undulating, deep, well drained clayey soils on uplands, terraces, and fans

This association is chiefly characterized by long and broad level terraces, smooth fans, and undulating uplands. A well-defined, shallow drainage pattern typifies the area. Slope range is mostly 0 to 8 percent. Soils in this association developed in clay alluvium and glacial till.

The Pendroy and Scobey soils are representative series in this association. Pendroy soils occupy terraces and fans. The Scobey soils are on uplands.

The Pendroy series typically has a grayish-brown clay surface layer about 7 inches thick. The underlying material is in two parts. The upper 35 inches consists of grayish-brown and gray clay, and the lower part to a depth of 60 inches is grayish-brown and gray silty clay.

The Scobey series typically has a grayish-brown clay loam surface layer about 6 inches thick. The subsoil, in the upper 6 inches, is brown clay, and the lower 7-inch depth is grayish-brown, calcareous clay loam. The underlying material, to a depth of 60 inches, is light brownish-gray and grayish-brown, calcareous clay loam.

This association is used for dryland crops and range. The native vegetation is mid- and shortgrasses. Most areas are used for dryland small grains and hay. This association is well suited to dryland crops or range. Soils in this association are subject to both wind and water erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 42 . Pendroy - Scobey association: Mainly level to undulating, deep, well drained clayey soils on uplands, terraces and fans (description)

State North central and west central Montana ; Extent 120 square miles; Average Annual Precipitation 10-14 inches;

Potential Evapotranspiration 25 inches; Average Frost-free Season 100-125 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Pendroy	20	Ustertic Torriorthents; very fine, montmorillonitic (calcareous), frigid	Clay	Alluvium	Well	40-60"	Moderate & High	Very slow	Low*	High	D
Scobey	15	Aridic Argiborolls; fine montmorillonitic	Loam	Glacial till	Well	40-60"	Moderate & High	Slow	Low*	Moderate	B

*If water is available, the frost potential is moderate.

Table 2.-- Soil Characteristics and Interpretations; Soil Association 42

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Winter Wheat units: bu/ac	(2) Spring Wheat bu/ac	(3) Barley bu/ac	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Lands: (1) Inches available	(2) Suitability
Pendroy clay, 0 to 2 percent slopes	IIIs	Medium	Medium	25	20	30	1200	Clay texture, very slow permeability	Severe--high shrink-swell, low strength	Severe--high shrink-swell, low strength	0	Poor: high clay content
Scobey, 2 to 8 percent slopes	IIIe	Medium	Medium or high	30	28	40	1200	Slope; slow permeability	Moderate-moderate shrink-swell, low strength	Moderate--moderate shrink-swell, low strength	19	Good or Fair: moderate clay content to 19"; Fair to Poor below; moderate alkalinity

1/ Ratings are given for residences, with basements, that are served by public sewers.

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43. Absher-Cabbart-Marmarth association

Mainly nearly level to rolling, well drained, high sodium soils on shale uplands

This association consists largely of nearly level to rolling soils on uplands that have claypan subsoils. Included in the association are hilly to steep areas on the sides of buttes and stream valleys and on the shoulders of entrenched drainageways.

Absher soils are deep, well drained claypan soils. Their surfaces are uneven because of the many small, mostly barren, low saline spots that dot the landscape. Absher soils have a thin surface layer of loam or silt loam and extremely hard, clayey subsoils overlying shale at depths ranging from 40 to 60 inches or more. Absher soils have very slow permeability, low or moderate available water capacity, and poor tilth.

Other important soils are Cabbart, Marmarth, and Oburn. The shallow, loamy Cabbart soils are in the steeper areas. The moderately deep, loamy Marmarth soils are on smooth, upland areas. Oburn soils have slightly thicker surface layers, but, otherwise, are similar to Absher soils with which they are intermingled.

Most of the area is used for range. The native vegetation consists of mid- and shortgrasses, and the cover is sparse in areas of the dominant Absher soil. Scattered areas of cropland are situated on the Marmarth and Oburn soils. Small grain and alfalfa are the main crops. Management practices that conserve moisture and control erosion are needed. The dominant Absher soils have severe limitations for building sites, roads, septic tank disposal fields, and recreation uses. Forbs and shrubs provide habitat for antelope.

Table 1 . Soil Characteristics and Interpretations

Soil Association 43 . Absher - Cabbart - Marmarth association: Mainly nearly level to rolling, well drained, high sodium soils on shale uplands (description)

State NW. South Dakota ; Extent 1344 square miles; Average Annual Precipitation 14 inches;

Potential Evapotranspiration 24 inches; Average Frost-free Season 128-135 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Absher	30	Borollic Natrargids, fine, montmorillonitic	Loam	Clay residuum from sedimentary rocks	Well to moderately well	60"	Moderate	Very slow	Low	High	D
Oburn	10	Borollic Natrargids, fine, montmorillonitic	Silt loam	Clay residuum from sedimentary rocks	Well	60"	Moderate	Very slow	Low	High	D
Cabbart	15	Ustic Torriorthents, loamy, mixed, (calcareous) frigid, shallow				10-20"	Very low	Moderate above bedrock	Low	Low	B
Marmarth	15	Aridic Argiborolls fine-loamy, mixed	Loam	Soft sandstone	Well	20-40"	Low or moderate	Moderate above bedrock	Moderate	Moderate	B

Table 2.--Soil Characteristics and Interpretations; Soil Association 43 227<

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1)Oats units:(Bu)	(2)S.Wheat (Bu)	(3)Alfalfa (Tons)	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Absher loam, 0 to 9 percent slopes	VIs	High	Low	--	--	--	800	Very slow permeability, high soluble salts	Severe--high shrink-swell potential, low strength	Severe--high shrink-swell potential, low strength	10-16	Poor:clayey high salt content
Oburn silt loam, 2 to 9 percent slopes	VIs	High	Low	--	--	--	1200	Very slow permeability, high soluble salts	Severe--high shrink-swell potential, low strength	Severe--high shrink-swell potential, low strength	10-16	Poor:clayey high salt content
Cabbart loam, 6 to 25 percent slopes	VIs	Very high	Low	--	--	--	1200	Slopes, 10 to 20" to bedrock	Moderate if <15 percent slopes; severe if >15 percent slopes; <20" to rippable bedrock	Moderate if <15 percent slopes; severe if >15 percent slopes	4-7	Fair:low fertility
Marmarth loam 2 to 6 percent slopes	IIIe	Medium	Medium	35	22	1.3	1800	Low and moderate AWC, 20 to 40" to bedrock	Slight	Moderate shrink-swell, frost action, low strength	20-40	Good

1/ Ratings are given for residences, with basements, that are served by public sewers.

44. Lambeth-Yamac-Absher association

Mainly undulating to hilly, deep, well drained soils on bottom lands and soft silty shale uplands

This association is characterized by rough, broken slopes at the edge of terraces and along deep drainageways, fans, and terraces adjacent to streams and in upland drainageways. A complex of well-defined deep and shallow drainage pattern typifies the area. Slope range is mostly 3 to 30 percent. Soils in this association developed in alluvium and soft silty shale.

The Lambeth, Yamac, and Absher soils are representative series in this association. Lambeth soils occupy rough, broken slopes along deep drainageways and ridges. Yamac and Absher soils occupy low terraces and fans in bottom lands and valleys.

The Lambeth series typically has a light yellowish-brown silt loam about 4 inches thick. The underlying material, to a depth of 60 inches, is a light yellowish-brown and pale yellow calcareous silt loam.

The Yamac series typically has a grayish-brown loam surface layer about 5 inches thick. The subsoil, about 13 inches thick, is in two parts. The upper 7-inch part is light olive-brown loam, and the lower 6-inch part is light yellowish-brown, calcareous loam. The underlying material, to a depth of 60 inches, is light yellowish-brown, calcareous loam.

The Absher series typically has a light brownish-gray, loam surface layer about 2 inches thick. The subsoil, about 22 inches

thick, is in two parts. The upper 14 inches are of grayish-brown silty clay, and the lower 8 inches of grayish-brown silty clay. The underlying material is light brownish-gray, calcareous silty clay about 12 inches thick, and light brownish-gray, calcareous, stratified clay loam, silty clay loam, and silty clay to 60 inches.

The association is used primarily for range and dryland crops. The native vegetation is mostly mid- and shortgrasses. This association is more suited for range and, to a lesser extent, to cultivated crops. The dryland crops are small grains and hay. Small grains and hay produce well under irrigation. Irrigation is confined to the bottom lands adjacent to streams and other sources of water. Soils in this association are subject to wind and water erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 44 . Lambeth - Yamac - Absher association: Mainly undulating to hilly, deep, well drained soils; on bottom lands and soft silty shale uplands (description)

State Eastern and southeastern Montana, northwestern South Dakota, and southwestern North Dakota ; Extent 12462 square miles; Average Annual Precipitation 10-14 inches;

Potential Evapotranspiration 24-26 inches; Average Frost-free Season 100-105 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Lambeth	30	Ustic Torriorthents; fine-silty, mixed (calcareous), frigid	Silt loam	Stratified silty and clayey sedimentary material	Well	40-60"	High	Moderately slow	Low*	Low	B
Yamac	15	Borollic Camborthids; fine-loamy, mixed	Loam	Alluvium	Well	40-60"	High	Moderate	Low*	Low	B
Absher	10	Borollic Natrargids; fine, montmorillonitic	Loam	Alluvium	Well to moderately well	40-60"	Low and moderate	Very slow	Low*	Moderate	D

*If water is available the frost potential is high.

Table 2 -- Soil Characteristics and Interpretations; Soil Association 44 231<

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Winter Wheat (2) Spring Wheat (3) Barley units: Bu.	Bu.	Bu.	b. Native Grazeable Resources, lb/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Lambeth silt loam, 8 to 15 percent slopes	IVe	High	Medium	25	22	30	1200	Slopes; moderately slow permeability	Moderate--slope	Moderate--slope, low strength	60	Fair to good; low to moderate lime content slopes
Yamac loam, 2 to 8 percent slopes	IIIe	Medium	High	26	24	36	1400	Slopes	Moderate--low strength	Moderate--low strength	60	Good, upper 12"; fair below; moderate lime content
Absher loam, 0 to 5 percent slopes	VIs	Low	Low	--	--	--	500	Very slow permeability moderately or strongly alkaline	Moderate--shrink-swell, low strength	Moderate--Moderate shrink-swell, low strength	4	Poor: high clay content, moderately or strongly alkaline

1/ Ratings are given for residences, with basements, that are served by public sewers.

84. Sansarc-Opal association

Mainly undulating to rolling, well drained, fine textured soils on soft clay shale uplands

This association consists of undulating to rolling clayey soils on broad upland plains and hilly to steep clayey soils on the sides of stream valleys and entrenched drainageways. Many drainageways, some with gullied channels, are in the area. The soils are formed in materials derived from the underlying soft clay shales.

Opal and Promise soils are moderately deep and deep, clayey soils. They have granular, clayey surface layers and extremely hard, clayey subsoils. These well drained soils range from undulating to rolling.

Sansarc soils are clayey soils that are shallow over shale. They are on ridge crests and the hilly to steep sides of stream valleys and drainageways. These are well drained soils.

Other important soils in the area include Agar and Dupree soils. The deep silty Agar soils are nearly level to sloping, and are on uplands and high terraces. The shallow, clayey Dupree soils are intermingled with Opal and Sansarc soils. Small areas of shale land are intermingled with Sansarc soils.

Table 1 . Soil Characteristics and Interpretations

Soil Association 84 . Sansarc - Opal association: Mainly undulating to rolling, well drained, fine textured soils on soft clay shale uplands (description)

State North central South Dakota ; Extent 2087 square miles; Average Annual Precipitation 16 inches;

Potential Evapotranspiration 25-26 inches; Average Frost-free Season 128-140 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Opal	25	Vertic Haplustolls, very fine, montmorillonitic, mesic	Clay	Clay residuum from shale	Well	20-40"	Low	Very slow	Low	High	D
Promise	8	Vertic Haplustolls, very fine, montmorillonitic, mesic	Clay	Clay residuum from shale	Well	60"	Low and moderate	Slow and very slow	Low	High	D
Sansarc	35	Typic Ustorthents clayey, montmorillonitic (calcareous), mesic, shallow	Clay	Clay residuum from Pierre shale	Well	10-20"	Very low	Slow	Low	High	D
Agar	1	Typic Argiustolls fine silty, mixed mesic	Silt loam	Loess	Well	60"	High	Moderate	Moderate	Moderate	B
Dupree	10	Paralithic Vertic Ustochrepts, clayey, montmorillonitic, mesic, shallow	Clay	Clay residuum from Pierre shale	Well	10-20"	Very low	Very slow	Low	High	D

Table 2.--Soil Characteristics and Interpretations; Soil Association 84

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Oats units (Bu)	(2) S. Wheat (Bu)	(3) Alfalfa (Tons)	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Opal clay, 2 to 9 percent slopes	IIIe	Medium	Medium	37	20	1.3	1900	Very slow permeability, 20 to40" to shale, low AWC	Severe: high shrink-swell potentia low strength	Severe--high shrink-swell potential, low strength	18-30	Poor: clayey
Promise clay, 2 to 6 percent slopes	IIIe	Medium	Medium	48	23	1.5	1900	Slow or very slow permeability, low or moderate AWC, long smooth slopes	Severe--high shrink-swell potentia low strength	Severe--high shrink-swell potential, low strength	18-30	Poor: clayey
Sansarc clay, 15 to 25 percent slopes	VIIs	Very high	Low	--	--	--	1400	Very low AWC, slopes, <20" to shale	Severe--high shrink-swell potentia slope, low strength	Severe--high shrink--swell potential, slope, low strength	6-14	Poor: clayey
Agar silt loam, 2 to 6 percent slopes	IIe	Low	Medium	50	24	1.9	2200	Favorable	Moderate moderate shrink-swell potential	Moderate--moderate potential frost action, shrink-swell	24-36	Good
Dupree clay, 9 to 25 percent slopes	VIIs	Very high	Low	--	--	--	1300	Very low AWC, slopes, <20" to shale	Severe--high shrink-swell potential, low strength slope	Severe--high shrink-swell potential, low strength, slope	6-14	Poor: clayey

1/ Ratings are given for residences, with basements, that are served by public sewers.

91. Shingle-Cushman association

Mainly undulating to hilly, well drained, loamy soils on shale and sandstone foothills and stream terraces

This is a narrow band of dissected mountain foothills and stream terraces. The soils are usually well drained and have sandy loam to clay loam surface layers and some have sandy clay loam or clay loam subsoils over dark clay shales or alluvium.

The soils of the mountain foothills are Shingle, Cushman, and Kim series. Alcova (warm variant) and Petrie soils are on stream terraces. The Shingle soils are shallow, and are on ridge crests and the steeper slopes. The medium depth Cushman soils are on pediments of less gradient. Kim soils are on alluvial fans. Alcova (warm variant) is underlain by sand and gravel. Petrie soils are strongly alkaline clayey soils on terraces.

Most of the land is used for rangeland and irrigated cropland and pasture. Some areas are used for urban and recreational uses. The irrigated cropland produces small grain, corn, and alfalfa. Natural vegetative cover is good, and consists of bunch grasses and shrubs.

A moderate to severe water erosion and sedimentation hazard exists. Wind erosion hazard is slight. The irrigated land is limited to the stream terraces and along some bottom lands in the foothills. Soils of the area provide habitat for deer, antelope, and pheasants. There are slight to moderate limitations for agriculture, recreation, roads, and urban development--except on steeper slopes which have severe limitations.

Table 1 . Soil Characteristics and Interpretations

Soil Association 91 . Shingle - Cushman association: Mainly undulating to hilly, well drained, loamy soils on shale and sandstone foothills and stream terrace (description)

State East central Wyoming ; Extent 744 square miles; Average Annual Precipitation 12-16 inches;

Potential Evapotranspiration 24 inches; Average Frost-free Season 115-140 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Shingle	30	Ustic Torriorthents, loamy, mixed, (calcareous) mesic, shallow	Clay loam	Interbedded shale and sandstone	Well drained	10-20"	Very low	Slow	Low	Moderate	D
Kim	10	Ustic Torriorthents, fine loamy, mixed (calcareous), mesic	Loam	Alluvium	Well drained	60"	High	Moderate	Low	Moderate	B
Petrie	5	Ustic Torriorthents, fine, montmorillonitic (calcareous), mesic	Clay loam	Alluvium	Well drained	60"	High	Slow	Low	High	C
Cushman	20	Ustollic Haplargids, fine-loamy, mixed mesic	Loam	Interbedded shale and sandstone	Well drained	24-30"	Low	Moderate	Low	Moderate	C
Alcova, warm variant	15	Borollic Haplargids, fine-loamy. over sandy or sandy-skeletal, mixed, mesic	Sandy loam	Alluvium	Well drained	60"	Moderate	Moderate	Low	Moderate	B

Table 2.--Soil Characteristics and Interpretations; Soil Association 91

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1)___ (2)___ (3)___ units:			b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Shingle clay loam, 10 to 25 percent slopes	VIIe	Very high	Low	--	--	--	1,000	Severe--slope, rooting depth	Moderate--slope, shrink-swell, depth to rock	Moderate--slope, shrink-swell, depth to rock	10	Fair - low fertility
Kim loam, 2 to 8 percent slopes	IVe	High	Medium	--	--	--	1,400	Moderate--slope	Moderate--shrink-swell; low strength	Moderate--low strength, shrink-swell	60	Good
Petrie clay loam, 3 to 6 percent slopes	VIe	Very high	Low	--	--	--	1,300	Severe--excess alkali	Moderate--low strength, shrink-swell	Severe--low strength, shrink-swell	60	Poor--excess alkali
Cushman loam, 6 to 15 percent slopes	VIe	Very high	Medium	--	--	--	1,400	Severe--rooting depth, slope	Moderate--slope and low strength, shrink-swell	Moderate--slope, shrink-swell, low strength	24	Good
Alcova sandy loam, warm variant, 3 to 6 percent slopes	VIe	Very high	Medium	--	--	--	1,600	Moderate--slope	Slight	Moderate--shrink-swell, low strength	26	Good

1/ Ratings are given for residences, with basements, that are served by public sewers.

94. Alice-Vetal-Valent association

Mainly undulating to rolling, well to excessively drained, fine sandy loam soils on aeolian and alluvial deposits

This is an undulating to rolling upland plain of predominantly deep, well drained, moderately coarse and coarse textured soils forming from aeolian and alluvial deposits, with some inclusions of loamy soils.

The dominant soils in this area are Alice, Vetal, and Valent. Alice and Vetal are deep, dark-colored sandy loam soils. Alice soils are on nearly level upland terraces, while Vetal soils are found in upland swales and drainageways. Valent soils are deep, loose sands on characteristic dune-like relief.

The land use is mostly rangeland, but there are areas that are cultivated for small grains, alfalfa, and sorghums. The native vegetative cover is good, and consists of mid and tall grasses. Where underground water supplies are available, pivot sprinkler systems are being installed.

Wind erosion is a severe hazard on cropland. Poor water-holding capacity and low rainfall make these soils droughty. Rangeland needs management for moisture conservation, wind erosion control, and fertility maintenance. These soils have slight to moderate limitations for rangeland and wildlife. They have moderate to severe limitations for recreation or camping areas. The loose, sandy soils, or the soils on steep slopes, are not suited for building sites or urban development; but the sandy loam soils on moderate slopes have only slight to moderate limitations for building sites, urban areas, or roads.

Table 1 . Soil Characteristics and Interpretations

Soil Association 94 . Alice - Vetal - Valent association: Mainly undulating to rolling, well to excessively drained, fine sandy loam soils on aeolian and luvial deposits (description)

State East central Wyoming ; Extent 356 square miles; Average Annual Precipitation 14-17 inches;

Potential Evapotranspiration 24-25 inches; Average Frost-free Season 120-145 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Alice	30	Aridic Haplustolls, coarse-loamy, mixed, mesic	Fine sandy loam	Alluvium & Aeolian	Well drained	60"	Moderate	Moderately rapid	Low	Low	B
Vetal	30	Pachic Haplustolls, coarse-loamy, mixed, mesic	Fine sandy loam	Alluvium & aeolian	Well drained	60"	Moderate	Moderately rapid	Low	Low	B
Valent	20	Udic Torripsamments, mixed, mesic	Fine sand	Aeolian sand	Excessively drained	60"	Very low	Rapid	Low	Low	A

Table 2.-- Soil Characteristics and Interpretations; Soil Association 24

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) W. Wheat units: Bu.	(2) Grass or mixed hay	(3) Barley	b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Lands (1) Inches available	(2) Suitability
Alice fine sandy loam, 0 to 3 percent slopes	IIIe	Medium	Medium	30	.75	25	1,600	Slight	Slight	Slight	60	Good
Vetal fine sandy loam, 6 to 10 percent slopes	IVe	High	Medium	15	.7	14	1,600	Moderate slope	Slight	Moderate-- slope, low strength	60	Good
Valent fine sand, 10 to 20 percent slopes	VIIe	Very high win erosion	Low	--	--	--	1,600	Severe-- slope, fast intake	Moderate to severe slopes	Moderate to severe slopes	60+	Fair-sandy

1/ Ratings are given for residences, with basements, that are served by public sewers.

99. Caputa-Pierre-Samsil association

Mainly level to hilly, well drained, loamy and clayey soils on old alluvium and shale uplands and terraces

This association consists of nearly level to undulating loamy soils and undulating to hilly clayey soils, on uplands and high terraces. Steeper slopes are on the sides of stream valleys and entrenched drainageways.

Caputa and Satanta soils are deep, well drained, loamy soils formed in alluvium. They have granular, loamy surface layers and hard subsoils of clay loam or clay. These soils have moderately slow or moderate permeability and high available water capacity.

Lismas and Samsil soils are undulating to hilly, clayey soils that are shallow over soft clay shale. These well drained soils have slow permeability and very low available water capacity.

Pierre soils are moderately deep, clayey soils. They have thin surface layers and very hard subsoils of clay. These undulating to hilly, well drained soils have very slow permeability and low or very low available water capacity.

Much of the Caputa and Satanta soils and some of the Pierre soils are in cultivation. Small grain, sorghum, alfalfa, and corn are the main crops. Conservation of moisture and control of erosion and soil blowing are the main concerns of management. The remainder of the area is used for range. The native vegetation consists of mid- and shortgrasses, and the vegetative cover is sparse in areas of Lismas and Samsil soils. Satanta soils have slight or moderate limitations for building sites, roads, septic tank disposal fields, and recreation uses; but the other soils in this association have severe limitations for these uses. The mixed land-use pattern of cropland and range combined with scattered trees and shrubs along streams and drainageways provide habitat for deer, pheasant, and sharp-tailed grouse.

Table 1 . Soil Characteristics and Interpretations

Soil Association 99 . Caputa - Pierre - Samsil association: Mainly level to hilly, well drained, loamy and clayey soils on old alluvium and shale uplands and terraces (description)

State W. South Dakota ; Extent 1041 square miles; Average Annual Precipitation 15 inches;

Potential Evapotranspiration 25 inches; Average Frost-free Season 135-140 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Caputa	25	Aridic Argiustolls, fine, mixed, mesic	Clay loam	Old alluvium	Well	60"	High	Moderately slow	Low	Moderate or high	C
Satanta	10	Aridic Argiustolls, fine-loamy, mixed, mesic	Loam	Old alluvium	Well	60"	High	Moderate	Moderate	Moderate	B
Samsil	15	Ustic Torriorthents, clayey, montmorillonitic (calcareous), mesic, shallow	Clay	Residuum from shale	Well	10-20"	Very low	Slow	Low	High	D
Pierre	25	Usteric Camborthids, very fine, montmorillonitic, mesic	Clay	Residuum from shale	Well	20-40"	Low	Very slow	Low	High	D

Table 2.--Soil Characteristics and Interpretations; Soil Association 99 243<

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Oats units (Bu)	(2) W. Wheat (Bu)	(3) Alfalfa (Tons)	b. Native Grazeable Resources pounds/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Caputa clay loam, 2 to 6 percent slopes	IIIe	Medium	Medium	26	26	1.2	1600	Favorable--High AWC, smooth slopes, moderately slow permeability	Severe--High shrink-swell potential low strength	Severe--Low strength, shrink-swell	20-36	Fair:clay loam textures
Satanta loam, 2 to 6 percent slopes	IIIe	Medium	Medium	30	28	1.3	1800	Favorable--High AWC, smooth slopes, moderate permeability	Moderate moderate shrink swell potential	Moderate--moderate shrink-swell potential, low strength, frost action	20-36	Good
Lismas clay, 15 to 40 percent slopes	VIIs	Very High	Low	--	--	--	800	Not suited; <20" to shale, steep slopes	Severe--High shrink-swell potential slopes, low strength	Severe--High shrink-swell potential, slopes, low strength	6-12	Poor:clayey
Samsil clay, 14 to 40 percent slopes	VIIs	Very High	Low	--	--	--	1200	Not suited; <20 inches to shale; steep slopes	Severe-High shrink-swell potential slopes, low strength	Severe--High shrink-swell potential, slopes, low strength	6-12	Poor: clayey
Pierre clay, 6 to 15 percent slopes	VIe	Very high	Medium	--	--	--	1700	Low AWC, very slow permeability	Severe--high shrink-swell potential shale at 20-40", low strength	Severe--high shrink-swell potential, low strength	16-30	Poor-clayey

1/ Ratings are given for residences, with basements, that are served by public sewers.

101. Mitchell-Rosebud association

Mainly nearly level to rolling, well drained, loamy soils on footslopes, fans, and sandstone uplands

This association of soils on nearly level to sloping fans and footslopes to steep uplands. The soils are well drained loams and silt loams. They are deep soils on the fans and footslopes and moderately deep and shallow soils underlain by soft siltstones on the steep uplands. There are inclusions of sandy and clayey saline and/or alkali soils and small areas of alluvial soils.

The dominant soils are Colby, Mitchell, Rosebud, and Epping. Colby and Mitchell are deep, light-colored silty soils. Colby soils are on uplands formed in loess. Mitchell soils are on terraces, colluvial slopes, and fans, and are forming in sediments washed or blown from weathered siltstone. Rosebud soils are moderately deep, and are found on rolling uplands underlain by weakly consolidated sandstone. Epping soils are shallow soils on rolling to steep uplands, and form from siltstone.

Most of the land is used for rangeland. There is very little dryfarming, but there are irrigated meadows along some of the streams. The native vegetation is short- and midbunch-grasses.

These soils have fair to good potential for wildlife habitat. They have slight to severe limitations for recreational use and moderate and severe limitations for roads and urban development.

Table 1 . Soil Characteristics and Interpretations

Soil Association 101 . Mitchell - Rosebud association: Mainly nearly level to rolling, well drained, loamy soils on foot-slopes, fans and sandstone uplands (description)

State East central Wyoming ; Extent 456 square miles; Average Annual Precipitation 12-15 inches;

Potential Evapotranspiration 24 inches; Average Frost-free Season 100-125 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Alice	10	Aridic Haplustolls Coarse-loamy, mixed, mesic	Fine sandy loam	Alluvium and aeolian	Well drained	60"	Moderate	Moderately rapid	Low	Low	B
Rosebud	20	Aridic Argiustolls Fine-loamy, mixed, mesic	Loam	Stratified sandstone and loamstone	Well drained	24-36"	Low	Moderate	Low	Low	B
Mitchell	25	Ustic Torriorthents, coarse-silty, mixed (calcareous) mesic	Silt loam	Alluvium and loess	Well drained	60"	High	Moderate	Low	Low	B
Colby	15	Ustic Torriorthents, fine-silty, mixed (calcareous), mesic	Silt loam	Alluvium and/or loess	Well drained	60"	High	Moderate	Low	Low	B
Epping	15	Ustic Torriorthents, loamy, mixed (calcareous) mesic, shallow	Silt loam	Siltstone	Well drained	10-20"	Very low	Moderate	Low	Low	D

Table 2.— Soil Characteristics and Interpretations; Soil Association 101

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Wheat (2) Barley (3) Grass or mixed hay units:			b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Alice fine sandy loam, 0 to 3 percent slopes	IIIe	Medium	Medium	30	35	1.0	1,400	Slight	Slight	Moderate--low strength	60	Good
Rosebud loam, 6 to 10 percent slopes	IVe	High	Medium	20	25	.75	1,400	Moderate--slope	Moderate--depth to rock, slope	Moderate--low strength, slope	30	Good
Mitchell silt loam, 3 to 10 percent slopes	IVe	High	Medium	20	25	.75	1,400	Slight to moderate--slope	Slight	Slight	60+	Good
Colby silt loam, 3 to 10 percent slopes	IVe	High	Medium	20	25	.75	1,400	Slight to moderate--slope	Slight	Moderate--low strength	60	Good
Epping silt loam, 10 to 15 percent slopes	VIIe	Very high	Low	--	--	--	1,100	Severe--slope, shallow to rock	Severe--shallow to rock	Severe--shallow to rock	15	Poor--shallow

1/ Ratings are given for residences, with basements, that are served by public sewers.

103. Trelona-Tassel-Satanta association

Rolling to steep, well to excessively drained, shallow to deep loamy soils on sandstone and shale uplands

This is an area of rolling to steep topography dissected by many small drainages. The soils are well drained, with loam or sandy loam surface and subsoil layers overlying sandstone or loamy shales at depths of 10 to 40 inches. There are inclusions of deep soils and steep breaks.

The dominant soils in this association are Tassel, Trelona, and Satanta. Tassel and Trelona are on steeply sloping uplands, usually on the crests and shoulders of ridges and hills. They formed in material weathered from the underlying soft sandstone bedrock which is found at less than 20 inches. Trelona has a darker surface layer and lacks free carbonates. The Satanta is a deep loamy soil on undulating uplands forming from aeolian material.

Rangeland is the principal use in this area. The native vegetation is mid-, tall, and bunchgrasses. Pine and juniper grow on many of the steeper breaks. Moderate to poor water-holding capacity and low rainfall make these soils droughty. Agricultural production is limited by inadequate moisture. The soils have slight to moderate limitations for rangeland and wildlife and moderate to severe limitations for recreation, roads, and urban development.

Table 1 . Soil Characteristics and Interpretations

Soil Association 103 . Trelona - Tassel - Satanta association: Rolling to steep, well to excessively drained, shallow to deep loamy soils on sandstone and shale uplands (description)

State Central Wyoming SW South Dakota ; Extent 360 square miles; Average Annual Precipitation 15 inches;

Potential Evapotranspiration 24 inches; Average Frost-free Season 130-140 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Trelona	30	Torriorthentic Haplustolls, loamy, mixed, mesic, shallow	Fine sandy loam	Soft sandstone	Well drained	10-20"	Very low	Moderately rapid	Low	Low	D
Satanta	20	Aridic Argiustolls Fine-loamy, mixed mesic	Loam	Wind reworked alluvium	Well drained	60"	Moderate and high	Moderate	Low	Low	B
Tassel	25	Loamy, mixed (calcareous), mesic, shallow	Fine sandy loam	Soft sandstone	Well drained	10-20"	Very low	Moderately rapid	Low	Low	D
Valent	10	Ustic Torripsamments, mixed, mesic	Fine sand	Aeolian sand	Excessively drained	60"	Very low	Rapid	Low	Low	A

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Table 2.--Soil Characteristics and Interpretations; Soil Association 103

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) units:			b. Native Grazeable Resources pun/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Trelona fine sandy loam, 10 to 20 percent slopes	VIIe	Very high wind erosion	Low	--	--	--	1,200	Severe--slope, shallow to rock.	Moderate to severe slope	Moderate to severe slope	15	Fair-sandy, shallow
Satanta loam 5 to 10 percent slopes	IVe	High wind erosion	Medium to high	--	--	--	1,400	Moderate--slope	Slight to moderate slope	Slight to moderate-slope, low strength	60+	Good
Tassel fine sandy loam, 10 to 30 percent slopes	VIIe	Very high wind erosion	Low	--	--	--	1,200	Severe--shallow to rock, slope	Moderate to severe-slope	Moderate to severe-slope, low strength	15	Fair-sandy, shallow
Valent fine sand, 10 to 20 percent slopes	VIIe	Very high wind erosion	Low	--	--	--	1,600	Severe--slope, fast intake	Moderate to severe, slope	Moderate to severe, slope	60+	Fair-sandy

1/ Ratings are given for residences, with basements, that are served by public sewers.

109. Marmarth-Kyle-Pierre association

Undulating to hilly, well drained, loamy and clayey soils on sandstone uplands

This association consists of well drained, loamy and clayey soils on uplands. Slopes are mostly undulating to rolling, but smaller, hilly areas are on the sides of ridges and along small streams and drainageways.

Marmarth soils are well drained loamy soils that have loam surface layers and hard loam or clay loam subsoils. The underlying soft sandstone or shale is at depths ranging from 20 to 40 inches.

Kyle and Pierre soils are at elevations slightly below that of Marmarth soils. They have thin clayey surface layers and subsoils of very hard or extremely hard clay. The underlying soft clay shale is at depths ranging from 20 to 40 inches in the Pierre soil and from 40 to 60 inches or more in the Kyle soil.

Other important soils in the area include the shallow, loamy Cabbart and the sandy Twilight series on the higher ridges.

Most of the area is used for range. The native vegetation consists of mid- and shortgrasses. Scattered areas of cropland occur on the Marmarth soils. Small grain and alfalfa are the main crops. Conservation of moisture, maintenance of fertility, and control of erosion and soil blowing are the main concerns of management. Limitations are moderate or severe for building sites, roads, septic tank disposal fields, and recreation uses. The mixed range and cropland land-use pattern, together with native trees and shrubs along small streams and drainageways, provide habitat for antelope, deer, and sharp-tailed grouse. Small populations of pheasant are in the cropland areas.

Table 1 . Soil Characteristics and Interpretations

Soil Association 109 . Marmarth - Kyle - Pierre association: Undulating to hilly, well drained, loamy and clayey soils on sandstone uplands (description)

State NW South Dakota ; Extent 1368 square miles; Average Annual Precipitation 15 inches;

Potential Evapotranspiration 25 inches; Average Frost-free Season 130-140 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Marmarth	25	Aridic Argiborolls, fine-loamy, mixed	Loam	Soft sandstone	Well	20-40"	Low and moderate	Moderate above bedrock	Moderate	Moderate	B
Kyle	15	Ustertic Camborthids, very-fine, montmorillonitic, mesic	Clay	Clay residuum from shale	Well	60"	Low and moderate	Very slow	Low	High	D
Pierre	15	Ustertic Camborthids, very-fine, montmorillonitic, mesic	Clay	Clay residuum from shale	Well	20-40"	Low	Very slow	Low	High	D
Cabbart	10	Ustic Torriorthents, loamy, mixed (calcareous) frigid, shallow	Loam	Materials weathered from siltstone or sandstone	Well to excessively	10-20"	Very low	Moderate above bedrock	Low	Low	B

Table 2 — Soil Characteristics and Interpretations; Soil Association 100

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) Oats units (Bu)	(2) S. Wheat (Bu)	(3) Alfalfa (Tons)	b. Native Grazeable Resources lf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Harmarth loam, 2 to 6 percent slopes	IIIe	Medium	Medium	35	22	1.3	1800	Low or moderate AWC, 20 to 40" to bedrock	Moderate-rippable bedrock at 20 to 40", shrink-swell, low strength	Moderate--shrink-swell, low strength, frost action	20-40	Good
Kyle clay, 2 to 6 percent slopes	IVe	High	Medium	25	22	1.1	1700	Low or moderate AWC, very slow permeability	Severe--high shrink-swell, low strength	Severe--high, shrink-swell, low strength	20-36	Poor-clayey
Pierre clay, 6 to 15 percent slopes	VIe	Very high	Medium	--	--	--	1700	Low AWC, very slow permeability	Severe--high shrink-swell, shale at 20-40"	Severe--high shrink-swell low strength	16-30	Poor-clayey
Cabbart loam, 6 to 25 percent slopes	VIe	Very high	Low	--	--	--	1200	Slopes, 10 to 20" to bedrock	Moderate to severe slope, less than 20" to rippable bedrock	Moderate to severe--slope, low strength	4-7	Fair-low fertility

1/ Ratings are given for residences, with basements, that are served by public sewers.

111. Limon-Winler-Epsie association

Undulating to steep, well drained, clayey soils on shale uplands

This is a dissected shale plain that has undulating to gently rolling, narrow divides, and hilly to steep valley walls. Bands of badland topography border many of the larger stream valleys. The soils are well drained and have granular clay surface layers, and may or may not have firm, blocky subsoil layers overlying bedded dark-colored shales at depths ranging from 10 to 40 inches. In some areas, the soils are forming from acid clay shales.

The fine textured soils that make up most of the area include Samsil, Gaynor, Limon, Winler, and Epsie soils. In the undulating to gently rolling areas, the shallow Samsil and Epsie soils are found on ridge crests, the moderately deep Gaynor and Winler soils occur on the upland side slopes of such ridges, and the deep Limon soils occupy fan positions in the lower lying drainageways at the foot of the upland slopes. Epsie and Winler soils are now calcareous to acid in reaction, and have a high concentration of gypsum and/or salt in the subsoil.

The land use is mostly rangeland, but small acreage is under cultivation for the production of small grains and alfalfa. Fertility is low, and the native vegetation of mid and tall grasses is often sparse on the shallow fine textured soils. Bur oak and pine occur on many areas.

Water erosion and sedimentation are severe hazards on slopes. Soils with friable or loose surface layers have a moderate wind erosion hazard. The soil characteristics and topography in much of the area combine so that there are moderate to severe limitations for agriculture, recreation, roads, urban development, and wildlife habitat except for deer and antelope.

Table 1 . Soil Characteristics and Interpretations

Soil Association 111 . Limon - Winler - Epsie association: Undulating to steep, well drained, clayey soils on shale uplands (description)

State NE Wyoming, SE Montana, western South Dakota ; Extent 6753 square miles; Average Annual Precipitation 10-18 inches;

Potential Evapotranspiration 24-25 inches; Average Frost-free Season 115-140 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Winler	15	Ustertic Camborthids, very fine, montmorillonitic, mesic	Clay	Clay shale	Well drained	24-36"	Very low	Very slow	Low	High	D
Limon	20	Ustertic Torriorthents, fine, montmorillonitic (calcareous), mesic	Silty clay	Alluvium	Well drained	60"	Moderate and high	Moderately slow	Low	High	C
Epsie	20	Ustic Torriorthents, clayey, montmorillonitic (calcareous), mesic, shallow	Clay	Platy Clay shale	Well drained	10-20"	Very low	Very slow	Low	High	D
Gaynor	15	Ustic Torriorthents, fine, montmorillonitic (calcareous), mesic	Silty clay loam	Silty shale	Well drained	24-40"	Low	Slow	Low	High	C
Samsil	15	Ustic Torriorthents, Clayey, montmorillonitic, (calcareous), mesic, shallow	Clay	Clay shale	Well drained	10-20"	Very low	Slow	Low	High	D

Table 2 .--Soil Characteristics and Interpretations; Soil Association 111

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) S.Wheat (2) mixed grass hay (3) ___ units:			b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Lands (1) Inches available	(2) Suitability
Minler clay 2 to 8 percent slopes	VIs	Very high	Low	--	--	--	1,300	Severe--slow intake	Severe--shrink-swell	Severe--shrink-swell, low strength	30	Poor-clay
Limon silty clay, 0 to 6 percent slopes	IVe	High	Medium	20	.7	--	1,300	Moderate to severe--slow intake	Severe--shrink-swell, low strength	Severe--shrink-swell, low strength	60	Fair-clay content
Epsie clay, 2 to 8 percent slopes	VIIe	Very high	Low	--	--	--	900	Severe--shallow to rock	Severe--shallow to rock	Severe--shrink-swell, low strength, shallow to rock	18	Poor - clay
Gaynor silty clay loam, 8 to 15 percent slopes	VIe	Very high	Low	--	--	--	1,300	Severe--slope	Severe--shrink-swell	Severe--shrink-swell, low strength	30	Fair-clay content
Samsil clay, 10 to 30 percent slopes	VIIe	Very high	Low	--	--	--	900	Severe--slope	Severe--shrink-swell	Severe--shrink-swell, low strength	14	Poor-clay

1/ Ratings are given for residences, with basements, that are served by public sewers.

115. Wanetta-Haverson association

Mainly level to undulating, deep, well drained soils on bottom lands, fans, and terraces

This association is mainly characterized by broad, level, and, to a lesser extent, undulating fans, terraces, and bottom lands along the major rivers. Slopes range from 0 to 8 percent. Soils in this association developed in loamy alluvium.

The Wanetta and Haverson soils are representative series in this association. The Wanetta series is on the undulating fans and nearly level terraces. The Haverson soils are on the bottom lands and are subject to flooding.

The Wanetta series typically has a light brownish-gray loam surface layer about 6 inches thick. The subsoil is about 11 inches thick, and is in two major parts. The upper 8 inches is brown clay loam, and the lower 3 inches is grayish-brown heavy loam. The underlying material is light brownish-gray loam and gravelly loam to a depth of about 32 inches, and below this is calcareous sand and gravel.

The Haverson series typically has a light brownish-gray loam about 6 inches thick. The underlying material, to a depth of about 60 inches, is light brownish-gray loam.

This association is used for dryland cultivation, mainly for small grains and for irrigated crops of hay, pasture, sugar beets, and corn for silage. Some areas are used for range. The native vegetation is mid- and shortgrasses. This association, as a whole, is well suited for irrigated cropland. With proper water management and fertility, it will produce good yields of sugar beets, corn for silage, potatoes, and pasture. The soils in the bottom lands are subject to flooding. Soils in this association are subject to wind erosion and, to a lesser degree, to water erosion.

Table 1 . Soil Characteristics and Interpretations

Soil Association 115 . Wanetta - Haverson association: Mainly level to undulating, deep, well drained soils on bottom lands, fans and terraces (description)

State South central Montana ; Extent 850 square miles; Average Annual Precipitation 10-14 inches;

Potential Evapotranspiration 25 inches; Average Frost-free Season 100-125 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Wanetta	25	Ustollic Haplargids; fine-loamy over sandy or sandy-skeletal, mixed, mesic	Loam	Alluvium	Well	20-40"	Low and moderate	Moderate in upper 20-40" Rapid below	Low*	Moderate to 20-40"	C
Haverson	20	Ustic Torrifluvents; fine-loamy mixed (calcareous) mesic	Loam	Alluvium	Well	40-60"	High	Moderate	Low*	Low	B

*If water is available, the frost potential is high.

Table 2 --Soil Characteristics and Interpretations; Soil Association 115

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1)W. Wh. (2) S. Wh. (3)Barley units:			b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Lands (1) inches available	(2) Suitability
Wanetta loam, 0 to 4 percent slopes	IIIs	low	high	32	26	40	1500	rapid permeability below 20-40 inches	Slight	Moderate Low Strength	20-40 inches	Good: 20-40 inches; Poor below
Haverson loam, 0-2% slopes	IIIc	low	medium or high	28	25	40	1500	Well suited	Severe-Subject to flooding	Moderate-Low Strength	60 inches	Good to Fair: Moderate lime content mildly or moderately alkaline

1/ Ratings are given for residences, with basements, that are served by public sewers.

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117. Cushman-Kim association

Undulating to rolling, well drained, loamy and clayey soils on sandstone and shale uplands

These are undulating to rolling upland plains underlain by interbedded sandstones, shales, and siltstones. The soils are well drained; have silty, loamy, or clayey surface and subsoil layers overlying bedrock at 20 to 60 inches. There are some areas of saline soils.

The interbedded bedrocks lead to a complex pattern of soils in much of the area; and, as a result, it is difficult to key particular soils to landforms or landscapes. Cushman and Briggsdale are moderately deep soils on nearly level to gently sloping upland plains. Kim and Ulm soils are deep, medium, and fine textured soils on alluvial fans below upland areas of mixed sedimentary bedrocks. Absted soils are deep and fine textured, with very strongly alkaline subsoils on alluvial fans and valley side slopes.

Nearly 75 percent of the area is in native short- and midgrasses and shrubs that provide forage for cattle and sheep. Gently sloping deep soils are dryfarmed to wheat and alfalfa. Narrow strips of land along the larger streams are irrigated. Forage crops and feed grains are the principal crops. Some land is in tame pasture.

Low rainfall is the limiting factor affecting yields for grasses and cropland. Moisture-conservation practices are necessary. Cropland areas need water and wind erosion control practices. The soils in this association have slight to moderate limitations for wildlife habitat. They have moderate and severe limitations for recreational purposes, roads, and urban development.

Table 1 . Soil Characteristics and Interpretations

Soil Association 117 . Cushman - Kim association: Undulating to rolling, well drained, loamy and clayey soils on sandstone and shale uplands (description)

State NE Wyoming and SE Montana ; Extent 11,654 square miles; Average Annual Precipitation 12-16 inches;

Potential Evapotranspiration 23-25 inches; Average Frost-free Season 120-140 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Cushman	30	Ustollic Haplargids, fine-loamy, mixed, mesic	Loam	Interbedded shale and sandstone	Well drained	24-30"	Low	Moderate	Low	Low	C
Ulm	15	Ustollic Haplargids, fine, montmorillonitic, mesic	Loam	Interbedded shale and sandstone	Well drained	60"	High	Moderately slow	Low	Moderate	B
Kim	15	Ustic Torriorthents, fine-loamy, mixed (calcareous) mesic	Loam	Alluvium	Well drained	60"	High	Moderate	Low	Moderate	B
Absted	10	Haplustollic Natrargids, fine, montmorillonitic, mesic	Very fine sandy loam	Alluvium	Well drained	60"	Moderate	Slow	High	High	D
Briggsdale	15	Ustollic Paleargids fine, montmorillonitic, mesic	Loam	Interbedded sandstone and shale	Well drained	24-36"	Low	Slow	Low	Moderate	C

Table 2 -- Soil Characteristics and Interpretations; Soil Association 117

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1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) W. Wheat (2) Grass or Mixed Hay (3) Barley units:			b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) inches available	(2) Suitability
Cushman loam 2-8% slopes	IVe	High	Medium	20	0.7	25	1400	Moderate - slope, rooting depth	Slight	Moderate - Low Strength	24"	Good
Ulm Loam, 2-8% slopes	IVe	High	Medium	20	0.7	25	1500	Moderate - slope	Moderate-shrink-swell low strength	Moderate-shrink-swell, low strength	60"	Fair - clay content
Kim Loam, 2-8% slopes	IVe	High	Medium	20	0.7	25	1500	Moderate - slope	Moderate-shrink-swell, low strength	Moderate - shrink-swell, low strength	60"	Good
Absted very fine sandy loam, 0-3% slopes	VIs	High wind erosion	Low	10	0.5	—	1400	Moderate - excess salt	Severe - high shrink-swell, low strength	Severe - high shrink-swell, low strength	60"	Poor-high clay content moderate salinity
Briggsdale loam, 2-8% slopes	IVe	High	Medium	18	0.5	—	1500	Moderate - slope	Moderate-shrink-swell, low strength	Moderate - shrink-swell, low strength	30"	Fair - clay content

1/ Ratings are given for residences, with basements, that are served by public sewers.

121. Butche-Canyon-Midway association

Mainly rolling to steep, shallow, well and excessively drained soils on ridges, valleys, and footslopes in sandstone and shale

This association consists of a series of uplift ridges and intervening valleys and footslopes that form a concentric ring around the Black Hills. The uplift ridges have steep angular slopes on the inner faces toward the Black Hills, and have longer, convex dip slopes on the outer side. The uplift ridges are notched by streams flowing out of the Black Hills, and are dissected by deeply, incised drainageways. The intervening areas consist of nearly level to gently sloping terraces and undulating to rolling foothills. Soils are formed in a series of siltstones, sandstones, and shales raised by the uplift.

Butche, Canyon, Grummit, and Midway soils are dominant. The Butche and the calcareous Canyon soils have loam textures and are shallow to sandstone. The clayey Grummit soils are shallow to acid clay shales. The calcareous Midway soils are silty clay loam or clay, and are shallow to shale.

Other important soils in this association include a number of deep, loamy, and clayey soils on bottom lands, terraces, and undulating to rolling foothills.

Most of the area is used for range. Native vegetation consists of mid- and shortgrasses. Scattered stands of bur oak and ponderosa pine are on the principal ridges of sandstone and acid shales. Much of the nearly level bottom lands and terraces is in cropland, and some is irrigated. Small grain and alfalfa are the main dryland crops. Corn and alfalfa are the irrigated crops. Conservation of moisture and control of erosion and soil blowing are the main concerns of management. Drainage is a problem in areas of irrigated clayey soils. Except for the deep loamy soils, limitations are severe for building sites, roads, septic tank fields, and recreation uses. Habitat in the area is favorable for deer and pheasant.

Table 1 . Soil Characteristics and Interpretations

Soil Association 121 . Butche - Canyon - Midway association: Mainly rolling to steep, shallow, well and excessively drained soils on ridges, valleys and footslopes in sandstone and shale (description)

State W. South Dakota and E. Wyoming ; Extent 2162 square miles; Average Annual Precipitation 14-18 inches;

Potential Evapotranspiration 23-24 inches; Average Frost-free Season 130-140 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Butche	20	Lithic Ustic Torriorthents, loamy, mixed, nonacid, mesic	Stony loam	Noncalcareous sandstone	Well and excessive	7-20"	Very low	Moderate above bedrock	Low	Low	B
Canyon	15	Ustic Torriorthents, loamy, mixed (calcareous) mesic, shallow	Loam	Residuum from calcareous sandstone	Well	6-20"	Very low	Moderate above bedrock	Low	Low	B
Grummit	10	Ustic Torriorthents, clayey, montmorillonitic, acid, mesic, shallow	Clay	Clayey residuum from acid shales	Well	10-18"	Very low	Moderate above shale	Low	High	D
Midway	15	Ustic Torriorthents, clayey, montmorillonitic (clayey), mesic, shallow	Silty clay	Clayey residuum from calcareous shales	Well	6-20"	Very low	Slow	Low	High	D

Table 2.--Soil Characteristics and Interpretations; Soil Association 171

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) ___ (2) ___ (3) ___ units:			b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Butche loam, 25 to 40 percent slopes	VIIs	Very high	Low	--	--	--	1500	Not suited; slopes, depth to bedrock	Severe--steep slopes <20" to hard bedrock	Severe--steep slopes, <20" to bedrock	7-20	Poor: stony, low fertility
Canyon loam, 25 to 50 percent slopes	VIIs	Very high	Low	--	--	--	1300	Not suited; slopes, depth to bedrock	Severe--steep sloped, <20" to rippable bedrock	Severe--steep slopes	6-20	Poor: limy low fertility
Grummit clay, 3 to 25 percent slopes	VIIs	Very high	Low	--	--	--	1300	Not suited; slopes, depth to bedrock	Severe--high shrink-swell, slope	Severe--high shrink-swell, slope	10-18	Poor: clayey
Midway silty clay loam, 6 to 25 percent slopes	VIIs	Very high	Low	--	--	--	1200	Not suited; slopes, depth to bedrock	Severe--high shrink-swell, slope, <20" to shale	Severe--high shrink-swell, slope, < 20" to shale	6-20	Poor: clayey, limy, low fertility

1/ Ratings are given for residences, with basements, that are served by public sewers.

123. Samsil-Shingle association

Mostly rolling to steep, shallow, well drained soils on uplands of sandstone and shale

This area consists primarily of shallow soils and bedrock exposures on steeply sloping badlands bordering the larger streams and in areas where the bedrocks have been uplifted. The bedrocks are interbedded sandstones and shales.

Samsil, Shingle, Renohill, and Haverson are the dominant soils in this area. Samsil and Shingle soils are found on steep slopes with shale and sandstone bedrocks at less than 20 inches. Samsil soils are fine textured, and Shingle soils are medium textured. Renohill soils are fine textured and moderately deep over shale bedrocks on gently sloping to steep uplands. Haverson soils are deep, medium textured alluvial soils in the flood plains of the larger streams and drainageways of smaller tributaries.

Except for small areas of irrigated land near the larger streams where forage crops are grown, the area is used as rangeland. Native short- and mid-grasses and shrubs produce limited amounts of forage for cattle and sheep. There are some scattered areas of scrub pine and juniper.

Low rainfall and shallow soils are factors that limit the yield of grass in this area. The soils in this area have moderate to severe limitations for wildlife habitat, except for deer and antelope. They usually have severe limitations for recreation use, roads, and urban development.

Table 1 . Soil Characteristics and Interpretations

Soil Association 123 . Samsil - Shingle association: Mostly rolling to steep, shallow, well drained soils on uplands of sandstone and shale (description)

State NE Wyoming, SE Montana ; Extent 14,045 square miles; Average Annual Precipitation 12-16 inches;

Potential Evapotranspiration 23-25 inches; Average Frost-free Season 120-140 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Samsil	30	Ustic Torriorthents, clayey, montmorillonitic (calcareous), mesic, shallow	Clay	Clay shale	Well drained	10-20"	Very low	Slow	Low	High	D
Shingle	30	Ustic Torriorthents, loamy, mixed (calcareous) mesic, shallow	Clay loam	Interbedded sandstone, shale and loamstone	Well drained	10-20"	Very low	Moderate	Low	High	D
Renohill	15	Ustollic Haplargids, fine, montmorillonitic, mesic	Clay loam	Shale	Well drained	24-36"	Low	Slow	Low	High	C
Arvada	5	Ustollic Natrargids, fine, montmorillonitic, mesic	Fine sandy loam	Alluvium	Well drained	60"	Low	Very slow	Low	High	D
Haverson	5	Ustic Torrifluvents, fine-loamy mixed (calcareous) mesic	Loam	Stratified alluvium	Well drained	60"	High	Moderate	Low	Low	B

Table 2 — Soil Characteristics and Interpretations; Soil Association 123

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1) ___ (2) ___ (3) ___ units:			b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Samsil clay, 10 to 30 percent slopes	VIIe	Very high	Low	--	--	--	900	Severe--slope	Severe--shrink-swell	Severe--shrink-swell, low strength	14	Poor: clay
Shingle clay loam, 15 to 30 percent slopes	VIIe	Very high	Low	--	--	--	900	Severe--slope	Severe--slope	Severe--shrink-swell, low strength slope	15	Poor: clay content
Renohill clay loam, 6 to 15 percent slopes	VIe	Very high	Medium	--	--	--	1300	Severe--slope	Moderate low strength	Severe--shrink-swell, low strength	30	Fair: clay content
Arvada fine sandy loam, 0 to 6 percent slopes	VIIs	Very high	Low	--	--	--	1000	Severe--permeability, alkali	Severe--shrink-swell, low strength	Severe--shrink-swell, low strength	60	Poor: clay content, alkali
Haverson loam, 0 to 3 percent slopes	IVe	High	Medium	--	--	--	2500	Slight	Severe--floods	Moderate--low strength	60	Good

1/ Ratings are given for residences, with basements, that are served by public sewers.

181. Dwyer-Valent-Tassel association

Undulating to rolling, deep, well drained, very sandy soils

This association of sandy soils has hummocky to dune topography. The soils are well drained, and some are underlain by interbedded sandstones and clay shales.

The principal soil series are the Dwyer, Valent, and Tassel. Dwyer and Valent soils are deep, loose sands. Tassel soil is shallow sandy loams underlain by soft sandstone.

The land is used for rangeland. Natural vegetative cover is good and consists of bunch grasses and shrubs.

Water erosion and sedimentation are slight hazards. Wind erosion hazard is severe. This area provides habitat for antelope.

Table 1 . Soil Characteristics and Interpretations

Soil Association 181 . Dwyer - Valent - Tassel association: Undulating to rolling, deep, well drained very sandy soils (description)

State E. Central Wyoming and N. Central North Dakota ; Extent 896 square miles; Average Annual Precipitation 12-14 inches;

Potential Evapotranspiration 22-24 inches; Average Frost-free Season 120-140 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Dwyer	35	Ustic Torripsamments, mixed, mesic	Fine sand	Aeolian sand	Excessively drained	60"	Very low	Rapid	Low	Low	A
Valent	30	Ustic Torripsamments, mixed, mesic	Fine sand	Aeolian sand	Excessively drained	60"	Very low	Rapid	Low	Low	A
Tassel	10	Ustic Torriorthents, loamy, mixed (calcareous) mesic, shallow	Fine sandy loam	Soft sandstone	Well drained	10-20"	Very low	Moderately rapid	Low	Low	D

Table 2.-- Soil Characteristics and Interpretations; Soil Association 181

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1)___ (2)___ (3)___ units:			b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Dayer fine sand, 3 to 10 percent slopes	VIe	Very high wind erosion	Low	--	--	--	1600	Severe--fast intake, slope	Slight to moderate--slope	Moderate--low strength, slope	60+	Fair: sandy
Valent fine sand, 10 to 20 percent slopes	VIIe	Very high wind erosion	Low	--	--	--	1600	Severe--slope, fast intake	Moderate to severe--slope	Moderate to severe--slope	60+	Fair: sandy
Tassel fine sandy loam, 10 to 30 percent slopes	VIIe	Very high wind erosion	Low	--	--	--	1000	Severe--shallow to rock, slope	Moderate to severe--slope	Moderate to severe--low strength, slope	15	Fair: sandy, shallow

1/ Ratings are given for residences, with basements, that are served by public sewers.

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184. Badlands-Cabbart association

Badlands and rolling to steep, shallow, well drained soils on uplands

This association is chiefly characterized by nearly vertical escarpments, narrow ridges, isolated buttes, deeply entrenched coulees, and rolling uplands. Slope range is mostly 8 to more than 30 percent. Soils in this association developed largely in siltstone sedimentary beds.

The miscellaneous land type, Badlands, and the Cabbart soil series are representative of this association. The Badlands make up the nearly vertical, hilly, and steeply sloping areas. Cabbart soils occupy the rolling and hilly portion of the landscape.

The Badlands consist of nearly barren, soft, multicolored sedimentary beds of loamy sand, sandy loam, silt loam, clay loam, and silty clay.

The Cabbart series typically has a light brownish-gray loam surface layer about 3 inches thick. The underlying material is light brownish-gray and pale yellow, calcareous loam about 15 inches thick. Soft platy siltstone and hard lenses of fine-grained sandstone is at a depth of about 18 inches.

The Badland areas of this association are suited only for recreation and wildlife. These areas are subject to very severe natural geologic erosion. The soils in this association are often used for range. The native vegetation is mid- and shortgrasses. Some small areas are used for dryland grain, but production is quite low due to droughtiness.

Table 1 . Soil Characteristics and Interpretations

Soil Association 184 . Badlands - Cabbart association: Mainly badlands and rolling to steep, shallow, well drained soils on uplands (description)

State North central Montana, southeastern Montana; western North Dakota, and southwestern South Dakota; Extent 6045 square miles; Average Annual Precipitation 10-14 inches;

Potential Evapotranspiration 23-25 inches; Average Frost-free Season 100-125 days

1 Dominant Soil Series	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Badlands	30	---	---	---	---	---	---	---	---	---	---
Cabbart	20	Ustic Torriorthents; loamy, mixed (calcareous), frigid, shallow	Loam	Silty and loamy material from weathered siltstone	Well	10-20"	Very low and low	Slow	Moderate*	Low or Moderate	D

*If water is available, the frost potential is high.

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Table 2.--Soil Characteristics and Interpretations; Soil Association 184

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1)___ (2)___ (3)___ units:			b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Badlands*	VIIs	Very High	Low	--	--	--	Very low	Not suited	Poorly suited	Variable	Variable	Variable
Cabbart Loam, 8 to 25 percent slopes	VIe	Very High	Low or Medium	--	--	--	1000	--	Moderate to severe rippable siltstone at 10-20", slope	Moderate to severe rippable siltstone at 10-20", slope	18	Poor: Less than 20" to siltstone

1/ Ratings are given for residences, with basements, that are served by public sewers.

*Characteristics of material is so variable that on-site inspection is needed. In places suitable final cover material is available in narrow valleys and on foot slopes and sideslopes

BLACK HILLS AREA

High, stony, and steep rocky ridges of metamorphic and igneous rocks form the central core of the Black Hills surrounded by high, rolling, and deeply dissected plateaus largely of limestone. Shallow, stony soils are dominant on the more rugged slopes. Deeper dark loamy or stony soils are on the lesser slopes in the open woodlands of the plateaus. Light-colored acid soils are on the forested slopes.

Most of the area is in forest and used for recreation and timber production. Small areas of open woodland, having a tall grass ground cover, provide a small amount of grazing. Some areas have been cleared, and are used to produce small grain and forage crops.

Water erosion and sedimentation are slight because of the hard rocks and forested cover. The larger streams provide water for livestock. Ground water is scarce.

The area is highly suitable for recreation, hunting, and wildlife habitat--primarily whitetail deer and wild turkey.

Table 1 . Soil Characteristics and Interpretations

Soil Association Black Hills . Black Hills (description)

State NE Wyoming and NW South Dakota ; Extent 888 square miles; Average Annual Precipitation 16-24 inches;

Potential Evapotranspiration 22 inches; Average Frost-free Season 100-124 days

1 Dominant Soil Series (Soils not classed at series level)	2 % of Assoc.	3 Classification (family)	4 Typical Texture of Surface Layer	5 Parent Material	6 Natural Soil Drainage Class	7 Depth of Rooting Zone	8 Available Water Capacity	9 Permeability (Least perm. layer)	10 Potential Frost Action	11 Shrink Swell Potential	12 Hydrologic Soil Group
Lithic Cryoborolls	15	Loamy-skeletal, mixed, shallow	Stony loam	Metamorphic & igneous	Well drained	10-20"	Very low	Moderately rapid	Moderate	Low	B
Typic Eutroboralfs	40	Loamy-skeletal, mixed	Stony loam	Igneous, metamorphic sandstone, limestone	Well drained	40-60"	Very low & low	Moderately rapid	Moderate	Low	B
Typic Argiborolls	15	Fine-loamy, mixed	Gravelly loam	Limestone, sandstone	Well Drained	40-60"	Low and Moderate	Moderately slow	Moderate	Moderate	B
Typic Argiborolls	10	Fine, montmorillonitic	Clay loam	Shales, interbedded w/sandstone	Well Drained	40-60"	Low and Moderate	Moderate	Moderate	High	C

Table 2 — Soil Characteristics and Interpretations; Soil Association Black Hills

1 Dominant Soil Phase	2 Land Cap. Sub-Class	3 Erodibility	4 Inherent Fertility	5 Estimated yields (high management) a. Dryland (specify crops) (1)___ (2)___ (3)___ units:			b. Native Grazeable Resources pdf/acre	6 Degree of Limitation for and Soil Features Affecting: a Irrigated Cropland	b Urban Uses 1/	c Road Location	d Final Cover for Mined Land: (1) Inches available	(2) Suitability
Lithic Cryoborolls 15-30% slopes	VIIe	Very High	Low	—	—	—	800	Severe - Slope, Stoniness	Severe- slope, stones, bedrock	Severe - slope, stones, bedrock	10"	Poor-slope, large stones
Typic Eutroboralfs 10-15% slopes	VIe	High	Medium	—	—	—	— (timber)	Severe - slope, stoniness, timber	Moderate- slope, stoniness, frost action	Moderate - slope, stones, frost action	40"	Poor - large stones, timber
Typic Argiborolls 10-15% slopes	VIe	High	Medium	—	—	—	1500	Severe - slope	Moderate- slope, frost action, shrink-swell	Moderate- slope, frost action, shrink-swell	40"	Good
Typic Argiborolls 10-15% slopes	VIe	High	Medium	—	—	—	1500	Severe- slope, slowly permeable	Severe- shrink-swell	Severe- shrink-swell, low strength	40"	Fair-clayey

1/ Ratings are given for residences, with basements, that are served by public sewers.

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BIBLIOGRAPHY

Aandahl, A. R.

1972. Soils of the Great Plains. Map legend. Lincoln, Neb.

Klingebiel, A. A., and P. H. Montgomery

1961. Land-capability classification. Agr. Handb. 210, Soil Conservation Service, USDA. 21 p.

Soil Conservation Service, USDA

1971. Guide for interpreting engineering uses of soils. U.S. Gov. Print. Office, Washington, D.C., 87 p., illus.

Soil Survey Staff, USDA

1951. Soil survey manual. USDA Handb. 18. U.S. Gov. Print. Office, 503 p.

Soil Survey Staff, USDA

Soil taxonomy. (In press). Soil Conservation Service, Washington, D.C.

Discussion draft
February 1974

NATURAL VEGETATION

I. INTRODUCTION

The kinds and amounts of plants which grow on any given area depend primarily upon the kind and nature of the soils supporting them and upon the climate. Such other factors as grazing, fire, insects, and plant diseases, either temporarily or permanently affect the growth of vegetation.

Because of the great variation in soils and climate within the Northern Great Plains, it is to be expected that natural vegetation would also be quite variable. Natural plant communities range from essentially short-grass turf with a few plant species to woodlands and forests with a rich variety of grasses, grass-like plants, forbs, shrubs, and trees. Boundaries between distinctive plant communities are sometimes very distinct, as when associated with abrupt changes in soils or available moisture. More often, however, boundaries are less distinct, and often cover a wide zone of transition when soil or climatic changes are gradual.

A large proportion of the lands within the NGPRP area (approximately 70 percent) are used primarily as rangeland. The descriptions of the natural plant communities in this discussion, therefore, are based on rangeland interpretation. It should be noted that rangelands are important for many essential uses and benefits, including water, wildlife, recreation, open space, corridor and urban buffer areas, natural waste cycling, esthetic

values, and for the purification of the air we breathe. Rangelands are a primary source of forage for domestic livestock and wildlife.

The grazing of herbage has been a natural process in the grasslands, shrub lands, and certain forest lands of the NGPRP area as long as grazing animals have existed. The effects of grazing on the environment depend on the time of year when grazing occurs, the intensity of grazing, the kind(s) of grazing animals, the management methods used to control grazing animals, the nature of the vegetation, and the soil upon which the plants grow.

Plant communities which developed under conditions of grazing use, as did most of those within the Northern Great Plains, are improved; and protective soil cover is best maintained under a moderate amount of grazing use. Many such plant communities actually deteriorate in the total absence of grazing.

Maintenance of a vigorous and productive plant cover holds the soil in place, reduces destructive water runoff, and usually is beneficial to wildlife habitats. Most rangelands within the area are better suited for their adapted uses today than they were 25 years ago because of better use and management now being employed.

Unregulated heavy grazing almost always results in loss of desirable forage plants, their replacement by less palatable or

less productive kinds, usually an increase in runoff and erosion, and often in reduced value for wildlife habitat, recreation, or watershed values. Desired changes in plant species and production result only from carefully regulated grazing programs designed to favor the functioning biological system of the grazing land. With few exceptions, therefore, proper management of grazing enhances most uses of rangeland, while poor grazing management detracts from such values. Too little grazing, especially in predominately grassland vegetation, often increases the hazard of destructive wildfires.

II. PROCEDURES

All information on natural vegetation contained herein was obtained from soil survey interpretations, range site descriptions, range condition guides, guides to initial stocking rates, and other data available in local Work Unit Technical Guides as currently in use by the Soil Conservation Service. Judgment values such as those used in determining grazing values are based upon available data and interview with experienced personnel working in the specific locations to which estimated data are applied.

Notes on wildlife habitat values of range sites are based upon local knowledge and observations of the actual use of the site by cited species of wildlife and on suitability of the natural plant community for wildlife habitat.

III. LIMITATIONS

Any information on the vegetation of an area as vast as that covered by the NGPRP must necessarily be of very general nature. It can serve only as an overall indication of the nature and variability of the vegetation which can be expected to occur in the area of concern.

Site specific studies are essential to any detailed resource use planning. During site specific investigations, the soil(s) may be identified and classified, and the range site(s) and their potential native vegetation may be specifically described both quantitatively and qualitatively. The present condition of the plant cover is also interpreted during site specific studies.

The specific value of vegetation to the livestock operating unit can be accurately assessed only onsite. A specific portion of a ranch enterprise (such as a natural meadow) may have far greater value to that operation because of its strategic location than it would have to other uses of the land.

It is only by site specific studies that the existence of rare or threatened plant or animal species may be verified, or that the existence of unique or scientifically valuable natural areas may be recognized.

Capability and facilities for providing detailed site specific studies are available in every county within the NGPRP area, and should be employed before land use decisions are made or before options for future uses and values are foregone.

IV. RESULTS

Role of Rangelands in Livestock Production

The grazing lands of the Northern Great Plains support important numbers of the breeding herds of cattle and sheep which produce calves and lambs for feedlots in the corn and feed-grain producing areas. The high cost of feed grains dictate that breeding herds--especially of cattle--be produced on the cheaper sources of feed which are the rangelands. These breeding herds subsist almost wholly on forages, including rangeland and pasture vegetation, harvested forages, and crop residues. Forages now supply 75 percent of the feed units consumed by beef cattle and 90 percent of the units consumed by sheep in the United States. Loss of use of a significant amount of grazing lands would aggravate the current scarcity of meat, wool, and forage.

Loss of grazing resources to mining or to any other destructive use would require a shift of animals to cropland, a reduction in numbers of livestock within the region, or possibly destructive grazing of remaining grazing lands. Because of the profitability of crop production, opportunities for diverting appreciable acreages of arable lands to forage production are severely limited, and will likely continue to be limited.

Fossil fuel energy requirements for producing beef cattle and sheep are much less on rangelands than anywhere else. These energy requirements would be greatly increased if harvested feed grains were substituted for native grazing in livestock production.

In addition, animal wastes are naturally recycled under grazing conditions, and do not contribute to pollution problems.

Although rangeland is often thought of as a vast area of homogeneous land with essentially uniform vegetation, this concept is obviously incorrect. Because of the diversity of kinds of rangeland and kinds of plant communities within the NGPRP area, it is necessary to classify or subdivide the different kinds of rangeland into units which cannot only be recognized in the landscape, but also be described. For this reason, the vegetation of the NGPRP area is herein described in terms of "range sites."

A range site is defined as a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. A range site is the product of all environmental factors responsible for its development. It is capable of supporting an original native plant community typified by an association of species different from that of other range sites in terms of kind or proportion of species, or in total productivity.

Basic to rangeland inventories and as ecological subdivisions of the landscape, range sites are the units into which the landscape is divided for study, evaluation, and management planning. Range sites provide the basis for mapping the landscape and for planning its uses, development, rehabilitation, and management of rangelands.

Range site information is useful, not only for determining suitability for such single uses as grazing, but also for making essential interpretations for the many additional uses and benefits of rangeland.

In the absence of abnormal disturbance and significant physical deterioration, the native plant community of a range site is considered to be "climax" (original, potential, near-climax are acceptable synonyms for climax) for the site. It is the native plant community best adapted to the particular environmental complex of the site. It is relatively stable and is in dynamic equilibrium with the total environment. Such natural disturbances as drought, fire, and grazing, are factors inherent in the development of the plant community. The original plant community for a range site, therefore, is not always best typified by areas that have been protected from these natural influences for prolonged periods.

In a specific geographic area, range sites are identified by evaluating and describing the distinctive climax plant communities that occur. Distinctive differences between sites are associated with differences in species composition or productivity, or both, of sufficient magnitude as to require different management for grazing or other appropriate uses. Data for plant community evaluation are derived from many sources, including:

1. Evaluation of relict (climax) stands of vegetation and associated soils on areas subjected to minimal abnormal disturbance.

2. Comparison of vegetation on areas receiving varying degrees of use, with similar areas receiving no use.
3. Evaluation and interpretation of research data dealing with natural plant communities and soils.
4. Review of early historical and botanical literature.
5. Interpolation and extrapolation of existing vegetation information from areas of known stability to other areas of similar soils, climate and microenvironment, or along environmental gradients.

Within areas of similar climate, specific natural plant communities are consistently associated with specific soils or with groups of soils having similar physical and chemical properties. Therefore, although a plant community may have been extensively altered by misuse or physical disturbance, the vegetation potential of the area may be accurately approximated by identification of the soil.

Because of the intimate relationship of natural plant communities and specific soils, the range sites described in this study are those which occur on the dominant soils as shown on the soil association map entitled "Soils of the Great Plains," copyrighted by Andrew R. Aandahl, 1972. It will be noted that some range sites occur in two or more soil associations, as shown on the above map. In a few instances, two different range sites may occur on the same soil within the same soil association. In

these instances, the soil association boundaries include such a wide range in climatic values that differences in natural plant communities result even on the same kind of soil.

It must be recognized that it would be impractical to attempt to delineate all soils or all range sites on maps of the scale available to the NGPRP. From sheer cartographic necessity, soils and range sites must be shown as associations on these mapping scales. Also, it is recognized that there are many inclusions of small amounts of range sites in addition to those selected as representative of the noncultivated portions of many of the soil associations. Some of these sites not described may be locally important on individual farms and ranches, but are insignificant when compared with the area within the soil association as a whole.

When two or more range sites are described within a single soil association, an estimate has been made of the percentage of the area occupied by each site.

The plant communities briefly described for each range site are, as indicated previously, those representative of the ecological potential for the site. They do not necessarily represent the present plant communities. For various reasons, including grazing misuse, most present vegetation is somewhat different than the original or climax vegetation. The degree of departure of the present plant community on a specific rangeland area from that of the potential for that site is expressed in terms of <u>range condition</u>. The plant cover is considered to be in

"excellent," "good," "fair," or "poor" condition, depending upon the degree of departure. For each range site described in the following pages, an estimate has been made of the percent of the included area on which the present vegetation falls within each of the indicated range condition classes.

For each described range site, an estimate has been made of the average total annual herbage production and, where data are available, the range in production which may be expected to occur during years when growing conditions may be better or poorer than the average for the site.

The range condition class does not necessarily reflect productivity. For example, an area in "fair" condition on a range site capable of producing 3,000 pounds per acre may be producing more herbage than an area of a different range site in "excellent" condition but which has a potential for only 1,000 pounds production per acre.

Production, in each case, is expressed in terms of air-dry above ground production of herbaceous plants plus current leaves and twigs of woody plants. Data are based on a combination of actual harvest and estimates.

The attached range site descriptions do not include forest or woodland sites. The woodland inventory prepared by the U.S. Forest Service is a more accurate appraisal of the woodland resource. The descriptions do, however, include reference to tree species which occur as part of the natural plant community.

The portion of this soil association within the NGPRP lies mostly within Rolette County, North Dakota with a small portion extending into neighboring Pierce County.

Range Sites:

Savannah Range Site - Border Vegetation Zone

This is the only range site of significance within the association. It occurs on the Kelvin and Bottineau soils.

The natural plant community includes a great variety of cool and warm-season plants represented by grasses, forbs and woody plants.

Typically, it has an open overstory of trees such as bur oak, green ash, American filbert and beaked filbert. Small patches of aspen occur in small drainages and on cool slopes. Tree canopy is variable to about 10 percent. There is usually some juneberry, woods rose and western snowberry intermingled with trees.

Major grasses are little and big bluestem, green needlegrass, western wheatgrass and porcupine grass. Sedges are very common and may make up to 15 percent of the plant community. A wide variety of forbs is normal.

The site occurs on undulating topography and this is reflected by the vegetation -- with the cool-season plants and the trees tending to be most common on north and east facing slopes.

Bur oak is the most common tree species. It normally attains a height of 25 to 40 feet.

When this area is in excellent condition, annual production ranges from 2,000 to 2,900 pounds per acre. About 20 percent of this production is from leaf and twig growth of woody plants.

It has been estimated that the present condition of the lands within this range site as described is as follows:

10 percent - Excellent
15 percent - Good
70 percent - Fair
5 percent - Poor

Because of the wide variety of forage and cover plants normal on this site, it has high habitat value for deer, ruffed grouse, and wild turkey. This land may also have moderate to high potential for scenery and recreational development.

This soil association lies within Bottineau, Rolette and Pierce Counties, North Dakota--within the Drift Prairie Vegetation Zone.

Range Sites:

Silty - Drift Prairie V.Z.

Except for a few minor inclusions, all the non-cultivated lands within this soil association fall within this range site. It occurs on Bearden, Clyndon, Gardenia and Overly soils.

Grasses are most abundant and include porcupine grass, needleandthread, western wheatgrass and small amounts of several others. The showy forbs make up 10 to 20 percent of the cover and include prairie groundsel, American vetch, prairie chickweed, gaillardia, flax, tall cinquefoil, and nickleaf milkvetch. Snowberry, prairie rose, silverberry and leadplant amorpha are common but do not produce very much.

Under conditions of misuse, the taller grasses are replaced partly or entirely by short grasses like blue grama and by sageworts and thistle.

Total annual production ranges from 1,800 pounds per acre during less favorable years to over 2,800 pounds during favorable years.

This site has high wildlife values because of the variety of forbs produced. It does not usually support enough cover for large game animals.

It has been estimated that the present condition of rangelands in this site is as follows:

15 percent - Excellent
60 percent - Good
20 percent - Fair
5 percent - Poor

Soil Association No. 9

The small amount of this association which occurs within the NGPRP area is in Bottineau County, North Dakota. It is in the Drift Prairie Vegetative Zone.

Range Sites:

Clayey - Drift Prairie V.Z.

This site occurs primarily on the Fargo and Hegne soils.

This is primarily a grassland site with cool-season species being most abundant. Important species are green needlegrass, western wheatgrass, needleandthread grass and some blue grama. There is a good variety of forbs making up to 10 percent of the stand and a few, scattered, woody plants. The green needlegrass tends to be more common in the low swales than in upland position.

Blue grama and fringed sagebrush usually become prominent following long periods of grazing misuse.

Production for this site has been estimated at 2,000 pounds per acre during unfavorable years to 2,500 pounds during more favorable seasons. Average annual production is likely about 2,200 pounds.

This site is a favored range of the sharptail grouse.

Present range condition has been estimated as:

25 percent - Excellent
60 percent - Good
15 percent - Fair

Note: In addition to the Clayey site, there is a small amount of the Silty range site occurring on Beaden soils within this association.

Soil Association No. 10

This soil association, within the NGPRP, lies in Kidder and Mc Lean Counties, North Dakota. It is within the Central Vegetative Zone.

Range Sites:

A. Silty - Central V.Z.

About 50 percent of the non-cultivated land within this association is occupied by the Silty range site. It occurs on the Fordville soil.

This is naturally a very productive grassland plant community. It is dominated by cool-season species, but has a good mixture of both cool- and warm-season kinds. Major species include green needlegrass, western wheatgrass, needleandthread, prairie junegrass, blue grama, big and little bluestems and both slender and bearded wheatgrasses. A wide variety of forbs makes up 10 percent or more of the normal plant mixture and include stiff sunflower, purple prairieclover, breadroot scurfpea, dotted gayfeather, and blacksamson. The few scattered woody plants are mostly fringed sagebrush, western snowberry, and prairie rose.

When the site is subjected to prolonged misuse, the taller growing plants die out and are replaced by blue grama, fringed sagebrush and sedges.

When in excellent condition, this site produces an average of over 2,100 pounds per acre of air-dry vegetation. Plot clippings indicate production may be as low as 1,200 pounds during very unfavorable years and may be over 2,200 pounds per acre during good years.

This is a favorable site for upland birds.

B. Shallow to Gravel - Central V.Z.

Making up virtually all of the other half of the non-cultivated land in this association is the Shallow to Gravel range site. It occurs on the Renshaw soils.

This grassland site also grows a mixture of cool- and warm-season grasses, important amounts of forbs and scattered woody plants. The most common grasses include needleandthread grass, western wheatgrass, prairie sandreed, and blue grama. Penn, sun, and needleleaf sedge are also common. Dotted gayfeather and silverleaf scurfpea are common forbs.

10 Continued

In depletion, blue grama, low sedges and low-value weeds become dominant.

Annual production has been noted to range from 800 pounds per acre during unfavorable years to 1,600 pounds during good years. It is estimated that the long-time average production would be about 1,500 pounds per acre.

This site, too has value for upland game birds.

It has been estimated that the lands within the two range sites in this association are presently in the following condition:

10 percent - Excellent
65 percent - Good
25 percent - Fair

Lands within soil association No. 12 in the NGPRP lie within Sheridan and Pierce Counties, North Dakota and within the Central Vegetative Zone.

Range Sites:

A. Silty - Central V.Z.

The Silty range site occupies about 70 percent of the non-cultivated soils within this association. It occurs on the Barnes and Svea soils.

This is naturally a very productive grassland plant community. It is dominated by cool-season species, but has a good mixture of both cool- and warm-season kinds. Major species include green needlegrass, western wheatgrass, needleandthread, prairie junegrass, blue grama, big and little bluestems and both slender and bearded wheatgrasses. A wide variety of forbs makes up 10 percent or more of the normal plant mixture and include stiff sunflower, purple prairieclover, breadroot scurfpea, dotted gayfeather, and blacksamson. The few scattered woody plants are mostly fringed sagebrush, western snowberry, and prairie rose.

When the site is subjected to prolonged misuse, the taller growing plants die out and are replaced by blue grama, fringed sagebrush and sedges.

When in excellent condition, this site produces an average of over 2,100 pounds per acre of air-dry vegetation. Plot clippings indicate production may be as low as 1,200 pounds during very unfavorable years and may be over 2,200 pounds per acre during good years.

This is a favorable site for upland birds.

B. Thin Upland - Central V.Z.

This site includes about 30 percent of the association and is on the Buse soil.

The natural vegetation is mostly grass of good variety. Common species are little bluestem, needleandthread grass, sideoats grama, and green needlegrass with smaller amounts of blue grama, western wheatgrass, and plains muhly. There are several low-growing sedges which are prominent but never dominant in the natural cover. Stiff sunflower, blacksamson, silverleaf scurfpea, and dotted gayfeather are common forbs. Scattered patches of prairie rose, buffaloberry and chokeberry grow in the small coulees.

12 Continued

With mismanagement, the taller grasses are replaced by thickened stands of sedge and blue grama and by low-quality weeds.

Annual production has been observed to range between 800 and 2,000 pounds per acre per year. Average production is about 1,600 pounds per acre.

This is a favorable wildlife habitat for upland birds and, to a limited extent, for deer.

It has been estimated that the present condition of the two range sites described above is:

10 percent - Excellent
60 percent - Good
30 percent - Fair

This soil association occurs in Burke, Renville, Ward, Sheridan, and Bottineau Counties, North Dakota. It is within the Drift Prairie Vegetative Zone.

Range Sites:

A. Silty - Drift Prairie V.Z.

With the exception of very small amounts of included soils, this range site occupies all the non-cultivated land within this association as it occurs within the present boundaries of the NGPRP. It occurs primarily on the Barnes, Svea, and Hammerly soils.

The natural plant community for this site is a wide mixture of grasses and forbs with only a scattering of woody plants. Both warm- and cool-season species are important.

Grasses are most abundant and include porcupine grass, needleandthread, western wheatgrass and small amounts of several others. The showy forbs make up 10 to 20 percent of the cover and include prairie groundsel, American vetch, prairie chickweed, gaillardia, flax, tall cinquefoil, and nickleaf milkvetch. Snowberry, prairie rose, silverberry and leadplant amorpha are common but do not produce very much.

Under conditions of misuse, the taller grasses are replaced partly or entirely by short grasses like blue grama and by sageworts and thistle.

Total annual production ranges from 1,800 pounds per acre during less favorable years to over 2,000 pounds during favorable years.

This site has high wildlife values because of the variety of forbs produced. It does not usually support enough cover for large game animals.

It has been estimated that the present condition of the rangelands in this site within this soil association is:

15 percent - Excellent
65 percent - Good
20 percent - Fair

Soil Association No. 16

Soils within the NGPRP in this soil association occur in Bottineau, McHenry and Pierce Counties, North Dakota. They are within the Drift Prairie Vegetative Zone.

Range Sites:

Although most of the soils in the association are used as cropland or pastureland, there are important amounts in the following range sites:

A. Sandy - Drift Prairie V.Z.

About 90 percent of the native grazing lands within this association fall within this range site. The major soils are Embden and Wyndmere.

The natural vegetation presents a fairly uniform cover of mid-grasses such as needleandthread, western wheatgrass and little bluestem but also containing scattered patches of prairie sandreed. About half the production is from the mid-grasses and about 20 percent from the characteristic clumps of prairie sandreed. Short grasses and sedges are common but not abundant. There is a wide variety of forbs which may make up 10 percent of the plant mixture. Shrubs are present but in very small amounts.

Short grasses, sedges and a large variety of weedy plants increase at the expense of the more productive grasses when the site is subjected to misuse.

This site is potentially very productive. Production ranges from 1,300 pounds during less favorable to over 2,600 pounds in favorable years. Average annual production is about 2,400 pounds per acre.

B. Subirrigated - Drift Prairie V.Z.

Only about 10 percent of the rangeland within this soil association falls within the Subirrigated range site. This is mostly the Hamar soils. The site is included here mostly because of its unusually high production potential.

The natural plant community is dominated by tall prairie grasses including big bluestem, switchgrass, Indiangrass and prairie cordgrass. A great variety of other grasses, sedges, and rushes are usually present but are seldom important. There is a small amount of a variety of forbs scattered throughout. Woody plants, if any, are confined to strips of willows along old depressions or channels.

16 Continued

When this site is continuously misused, the tall grasses are replaced by Kentucky bluegrass, sedges, rushes, weeds, and sometimes partly by thickened stands of willows and cinquefoil.

Annual air-dry production in excellent condition ranges from 3,500 to 4,500 pounds per acre with an average production of about 4,000 pounds per acre.

Both the above range sites have wildlife values. Because of usual proximity to croplands, they are especially valuable for upland game birds.

It has been estimated that the present condition of the above two range sites as they occur in this soil association is as follows:

10 percent - Excellent
60 percent - Good
25 percent - Fair
5 percent - Poor

Over 6,000 square miles of this soil association lies within the NGPRP area in North Dakota. It occurs in several scattered tracts with portions within Burke, Burleigh, Divide, McKenzie, Mercer, Mountrail, Renville, Sheridan, Ward, Williams, Emmons and Kidder Counties.

Most of the land within this association is under cultivation.

Range Sites:

A. Silty - Central V.Z.

Approximately 75 percent of the non-cultivated land within the association is in the Silty range site. It is found primarily on the Williams and Bowbells soils.

This is naturally a very productive grassland plant community. It is dominated by cool-season species, but has a good mixture of both cool- and warm-season kinds. Major species include green needlegrass, western wheatgrass, needleandthread, prairie junegrass, blue grama, big and little bluestems and both slender and bearded wheatgrasses. A wide variety of forbs makes up 10 percent or more of the normal plant mixture and include stiff sunflower, purple prairieclover, breadroot scurfpea, dotted gayfeather, and blacksamson. The few scattered woody plants are mostly fringed sagebrush, western snowberry and prairie rose.

When the site is subjected to prolonged misuse, the taller growing plants die out and are replaced by blue grama, fringed sagebrush and sedges.

When in excellent condition, this site produces an average of over 2,100 pounds per acre of air-dry vegetation. Plot clippings indicate production may be as low as 1,200 pounds during very unfavorable years and may be over 2,200 pounds per acre during good years.

This is a favorable site for upland birds.

B. Thin Uplands - Central V.Z.

Nearly 25 percent of the non-cultivated land is in the Thin Uplands range site. The site is usually associated with the Zahl soils.

The natural vegetation is mostly grass of good variety. Common species are little bluestem, needleandthread grass, sideoats grama, and green needlegrass with smaller amounts of blue grama, western wheatgrass, and plains muhly. There are several low-growing sedges which are prominent but never dominant in the natural cover. Stiff sunflower, blacksamson, silverleaf scurfpea, and dotted gayfeather are common forbs. Scattered patches of prairie rose, buffaloberry and chokecherry grow in the small coulees.

19 Continued

With mismanagement, the taller grasses are replaced by thickened stands of sedge and blue grama and by low-quality weeds.

Annual production has been observed to range between 800 and 2,000 pounds per acre per year. Average production is about 1,600 pounds per acre.

This is a favorable wildlife habitat for upland birds and, to a limited extent, for deer.

C. Wet Meadows

Several very small, scattered areas of the Wet Meadow range site occur on Tonka soils. Although locally important because of high productive potential, the total acreage is insignificant in the association.

It has been estimated that the present range condition of the range sites within this soil association is:

10 percent - Excellent
75 percent - Good
15 percent - Fair

Soils within this association lie within McLean and Mercer Counties, North Dakota and within the Central Vegetative Zone. Most of the land is cultivated.

Range Sites:

A. Silty - Central V.Z.

About 70 percent of the non-cultivated agricultural land within this soil association is in the Silty range site. It is associated with the Williams and Temvik soils.

This is naturally a very productive grassland plant community. It is dominated by cool-season species, but has a good mixture of both cool- and warm-season kinds. Major species include green needlegrass, western wheatgrass, needleandthread, prairie junegrass, blue grama, big and little bluestems and both slender and bearded wheatgrasses. A wide variety of forbs makes up 10 percent or more of the normal plant mixture and include stiff sunflower, purple prairieclover, breadroot scurfpea, dotted gayfeather, and blacksamson. The few scattered woody plants are mostly fringed sagebrush, western snowberry, and prairie rose.

When the site is subjected to prolonged misuse, the taller growing plants die out and are replaced by blue grama, fringed sagebrush and sedges.

When in excellent condition, this site produces an average of over 2,100 pounds per acre of air-dry vegetation. Plot clippings indicate production may be as low as 1,200 pounds during very unfavorable years and may be over 2,200 pounds per acre during good years.

B. Clayey - Central V.Z.

This range site is associated with the Bearpaw soils and makes up about 30 percent of the non-cropland area within this association.

The natural plant community is dominated by cool-season grasses but with a mixture of warm season species, moderate amounts of forbs and usually scattered woody plants. Western wheatgrass is most abundant. Needleleaf and other sedges are common, as is Kentucky bluegrass. Green needlegrass and blue grama usually make up significant amounts of the plant community.

When subjected to continued misuse, Kentucky bluegrass and blue grama usually become dominant along with a big increase in weedy plants.

21 Continued

The site is estimated to produce about 1,900 pounds per acre on the average, with yearly production varying from 1,200 to 2,200 pounds per acre.

This site has moderate value as habitat for upland birds and occasionally is used by deer when it occurs in large enough tracts.

The present condition of the rangeland in this association has been estimated as follows:

15 percent - Excellent
75 percent - Good
10 percent - Fair

This soil association includes parts of Golden Valley, Stillwater, Yellowstone, and Bighorn Counties, Montana. Except for a few slightly higher elevations, the areas are within the 10-14" precipitation zone.

Range Sites:

A. Clayey

About 50 percent of the area is characterized by Castner soils which fall within the Clayey range site. Because of elevation and precipitation differences within the area covered, two range sites are involved, as follows:

(1) Clayey - 10-14" P.Z.

Dominant climax species are bluebunch wheatgrass, western wheatgrass, green needlegrass, biscuitroot, wild onion, and scattered plants of big sagebrush.

This site provides fair habitat for antelope, mule deer, sharptail and sage grouse and other upland species of wildlife.

Production, when in excellent condition, varies from 800 to 1,200 pounds per acre, depending upon moisture and temperature conditions.

(2) Clayey - 15-19" P.Z.

Dominant species in the natural plant community are bluebunch wheatgrass, Idaho fescue, western wheatgrass, columbia wheatgrass, eriogonum, wild onion, and scattered big sagebrush.

Production in excellent condition is from 1,100 to 1,600 pounds per acre.

This site has wildlife habitat values for antelope, deer, and upland game birds.

B. Shallow - 10-14" P.Z.

About 50 percent of the native grazing land within this association is in the Shallow range site. It is typically associated with the Castner soils.

Bluebunch wheatgrass, needleandthread, prairie junegrass and small amounts of prairie sandreed characterize the natural plant community. Blue grama is also present as well as moderate amounts of a mixture of native forbs and scattered individual plants or clumps of big sagebrush. Ponderosa pine is common on very shallow and rocky areas.

22 Continued

This site provides good deer habitat. It is also used by antelope, and upland game birds.

When in excellent condition this site produces from 600 to 900 pounds of air-dry herbage per acre.

It is estimated that the present condition of the rangelands within this association is as follows:

20 percent - Excellent
35 percent - Good
45 percent - Fair

This soil association is made up of several areas of land scattered among Burke, Burleigh, Divide, McKenzie, McLean, Mercer, Mountrail, Oliver, Ward and Williams Counties in North Dakota as well as Roosevelt and Sheridan Counties in adjacent Montana. Although the association includes a rather wide range of climatic conditions, it is considered to be within the Central Vegetative Zone for the purpose of the following range site descriptions.

Range Sites:

A. Silty - Central V.Z.

About 85 percent of the non-cropland within the association is in the Silty range site. This includes lands on Williams and Max soils.

This is naturally a very productive grassland plant community. It is dominated by cool-season species, but has a good mixture of both cool- and warm-season kinds. Major species include green needlegrass, western wheatgrass, needleandthread, prairie junegrass, blue grama, big and little bluestems and both slender and bearded wheatgrasses. A wide variety of forbs makes up 10 percent or more of the normal plant mixture and include stiff sunflower, purple prairieclover, breadroot scurfpea, dotted gayfeather, and blacksamson. The few scattered woody plants are mostly fringed sagebrush, western snowberry, and prairie rose.

When the site is subjected to prolonged misuse, the taller growing plants die out and are replaced by blue grama, fringed sagebrush and sedges.

When in excellent condition. this site produces an average of over 2,100 pounds per acre of air-dry vegetation. Plot clippings indicate production may be as low as 1,200 pounds during very unfavorable years and may be over 2,200 pounds per acre during good years.

This is a favorable site for upland birds.

B. Thin Uplands - Central V.Z.

About 15 percent of the non-cultivated land, mostly on Zahill and Zahn soils fall within the Thin Upland range site.

The natural vegetation is mostly grass of good variety. Common species are little bluestem, needleandthread grass, sideoats grama, and green needlegrass with smaller amounts of blue grama, western wheatgrass, and plains muhly. There are several low-growing sedges which are prominent but never dominant in the natural cover. Stiff sunflower, blacksamson, silverleaf scurfpea, and dotted gayfeather are common forbs. Scattered patches of prairie rose, buffaloberry and chokecherry grow in the small coulees.

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With mismanagement, the taller grasses are replaced by thickened stands of sedge and blue grama and by low-quality weeds.

Annual production has been observed to range between 800 and 2,000 pounds per acre per year. Average production is about 1,600 pounds per acre.

This is a favorable wildlife habitat for upland birds and, to a limited extent, for deer.

Present range condition for the rangelands listed above is estimated as follows:

15 percent - Excellent
70 percent - Good
15 percent - Fair

This soil association includes nearly 7,000 square miles in the northeast corner of Montana. Portions of the large association fall within Daniels, Dawson, Richland, Roosevelt, Sheridan, Valley, and McCone Counties. Despite the large area covered, natural plant communities within its boundaries are remarkably similar. It falls within the 10-14" precipitation zone. Much of the area is cultivated.

Range Sites:

A. Silty - 10-14" P.Z.

About 60 percent of the non-cultivated land is in the Silty range site. This area is typified by the Williams soils.

The dominant plants in the potential plant community are little bluestem, needleandthread, western wheatgrass, blue grama and threadleaf sedge. There is a good variety of native forbs and small patches of woody plants in the valley bottoms. Scattered silver sagebrush is common on the bottoms.

The site provides useful habitat for mule deer, whitetail deer, antelope and upland game birds.

When in excellent condition, production is from 900 to 1,300 pounds per acre per year.

B. Thin Hilly - 10-14" P.Z.

Approximately 40 percent of the non-cultivated area is within this range site. The Zahill soils are most common.

The natural plant community for this range site is also mid-grass with scattered woody plants and a wide variety of forbs. Most abundant species include little bluestem, sideoats grama, prairie sandreed, western wheatgrass, and needleandthread. Skunkbush sumac is a common, though not abundant, shrub.

The site has value habitat for both deer and upland game birds.

When in excellent condition, annual production varies from year to year from 600 to 900 pounds per acre.

It has been estimated that the present condition of the rangelands within this soil association is:

A. North of Missouri River
5 percent - Excellent
30 percent - Good
60 percent - Fair
5 percent - Poor

B. South of Missouri River
15 percent-Excellent
40 percent - Good
45 percent - Fair

This soil association includes portions of Fallon and Wibaux Counties in Montana and Golden Valley County in North Dakota.

Range Sites:

A. Clayey - 10-14" P.Z.

This range site occurs on the Bearpaw soils and makes up about 70 percent of the non-cultivated area within the association.

The natural plant community is typically a mixture of mid- and short grasses with small amounts of a fairly wide variety of forbs. It naturally produces little or no woody vegetation.

Major species include western wheatgrass, green needlegrass, prairie junegrass, and blue grama. There are several native leguminous species and biscuitroot is common.

The area has value as habitat for antelope and upland game birds.

When in excellent condition, production ranges from about 900 pounds per acre during unfavorable years to as high as 1,300 pounds per acre in favorable years.

B. Thin Hilly - 10-14" P.Z.

About 30 percent of the non-cultivated land is dominated by Zahill soils and falls within the Thin Hilly - 10-14" P.Z. range site.

Species prominent in the natural plant community are little bluestem, green needlegrass, bluebunch wheatgrass, prairie junegrass, plains muhly, and native legumes. Skunkbush sumac is also common to this site though it never makes up a significant part of the production.

The site is used by antelope, mule deer and by upland game birds.

Annual production on this site varies from 600 to 900 pounds per acre.

It is estimated that the present condition of rangelands within this soil association is as follows:

20 percent - Excellent
40 percent - Good
40 percent - Fair

Within the area covered by the NGPRP, this soil association occurs only in Musselshell County, Montana.

Range Sites:

The two major range sites in this soil association fall within different precipitation zones because of the variations in elevation within the area.

A. Silty - 15-19" P.Z.

This range site is associated with the Judith soils which lie at higher elevations and nearer the adjacent mountains. The site occupies about 50 percent of the non-cultivated land.

The natural plant community is characterized by rough fescue, bluebunch wheatgrass, Idaho fescue, green needlegrass and a variety of perennial forbs. An open stand of ponderosa pine is characteristic of this site.

Mule deer and sharptail grouse have been observed making use of this site.

When in excellent condition, the site produces from 1,500 to 2,100 pounds per acre.

B. Limy - 10-14" P.Z.

The Limy - 10-14" P.Z range site is associated with the Musselshell soils which generally lie at lower elevations and at greater distance from the mountains than do the Judith soils. This site includes about half the non-cultivated land within the soil association.

Needleandthread, western wheatgrass and threadleaf sedge are the major herbaceous species in the plant community. Forbs are not abundant but occur in some variety. Scattered plants of big sagebrush are almost always present.

The site is used by antelope, mule deer and upland game birds.

When in excellent condition, this range site produces from 600 to 900 pounds per acre.

It is estimated that the present condition of the rangelands is:

5 percent - Excellent
30 percent - Good
60 percent - Fair
5 percent - Poor

This soil association is in southwestern North Dakota and northwestern South Dakota. It occurs in Adams, Burleigh, Dunn, Grant, Hettinger, Sioux, and Stark Counties in North Dakota as well as in Corson, Dewey and Perkins Counties, South Dakota. This association is within the Missouri Slopes Vegetation Zone.

Range Sites:

A. Sandy - Missouri Slope V.Z.

This range site makes up about 50 percent of the non-cultivated portions of the association and occurs typically on the Vebar soils.

The natural plant community is dominated by needleandthread grass and prairie sandreed. Other important grasses are prairie junegrass, blue grama, western wheatgrass, and green needlegrass. Upland sedges occur in moderate amount. There is a good representation of forbs such as western yarrow, silverleaf scurfpea, and shell-leaf penstemon. Small patches and clumps of western snowberry and leadplant amorpha are the usual woody plants.

Under grazing misuse, the needleandthread, green needlegrass, prairie sandreed, and leadplant amorpha are partly or fully replaced by blue grama, upland sedges, sand dropseed and weedy plants. In severe depletion, thin stands of stunted sod-forming grasses and many weeds are usual.

Annual production varies from approximately 1,700 to 2,300 pounds per acre, depending upon the growing season. Long-term average production in excellent condition is probably about 2,000 pounds per acre.

This site has a high habitat potential for antelope and is suitable also for deer, upland game birds and smaller animals. The variety of forbs provides seasonal color.

B. Silty - Missouri Slopes V.Z.

About 35 percent of the rangelands are in the Silty range site. They occur primarily on the Morton soils although much of the Morton soil area is now in cultivation.

The potential plant community is dominated by mid-grasses. Prominent species are western wheatgrass, needleandthread grass, and green needlegrass. Blue grama usually makes up an appreciable amount of the cover also. Other common grasses are prairie junegrass and sandberg bluegrass. Penn sedge, threadleaf sedge and needleleaf sedge are commonly associated with the shorter grasses. Forbs typically contribute about 10 percent of the plant cover and include such species as heath aster, prairie coneflower, green sagewort, scarlet globemallow, and purple prairieclover. The few, usually scattered woody plants are prairie rose, western snowberry, silver sagebrush, fringed sagebrush and, occasionally, winterfat.

Following continued heavy grazing use, the plant cover becomes dominated by blue grama, sedges and weeds with very low productivity.

When in excellent condition, this site produced from 1,650 to 2,250 pounds per acre with an average production of about 1,950 pounds.

The site has value for antelope, deer, upland game birds such as the sharp-tailed grouse, and lesser small birds and mammals.

C. Shallow - Missouri Slopes V.Z.

This site makes up only about 15 percent of the native grazing lands within the association and occurs primarily on the Flasher soils. A brief description is included because of significant differences in the potential plant community between this and the two range sites listed above.

The site is naturally dominated by a mixture of cool- and warm-season mid-grasses. Prominent are western wheatgrass, needleandthread grass, little bluestem and prairie reedgrass. Others include plains muhly, sideoats and blue grama, and a variety of sedges. Forbs are scattered throughout and, though they contribute only about 10 percent of the production, they add variety and color. Common forbs are blacksamson, hairy goldaster, skeletonweed, purple prairieclover, dotted gayfeather, and stiff sunflower. Fringed sagewort, winterfat, western snowberry and shrubby cinquefoil are the major woody species although there are frequently small patches of buffalo brush and juniper in the pockets and small depressions.

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Following continued misuse, the more palatable and productive mid-grasses are replaced by blue grama, sedges and weedy plants.

Average annual production on this site is about 1,400 pounds per acre but it varies from year to year from 1,150 to 1,650 pounds.

The site has moderately high value as habitat for antelope, deer, upland game birds and associated wildlife species.

Present condition of the rangelands within this association has been estimated as follows:

30 percent - Excellent
60 percent - Good
10 percent - Fair

This soil association occurs in Bighorn, Custer, Powder River, Rosebud, and Treasure Counties, Montana.

Range Sites:

A. Shallow - 10-14" P.Z.

About 80 percent of the non-cultivated lands within the association are within this range site. There is some local variation both in species and production because of a rather wide range in elevation within the area. This site occurs primarily on the Ringling and Cabba soils.

The natural plant community is a widely-spaced stand of ponderosa pine with an understory of grasses, forbs and scattered big sagebrush. Major understory species are little bluestem, bluebunch wheatgrass, sideoats grama, western wheatgrass, and needleandthread.

The site furnishes valuable habitat for mule deer, sharptail and sage grouse, Hungarian partridge, and wild turkey.

When in excellent condition, the site produces from 800 to 1,200 pounds per acre, depending on the kind of growing season.

B. Silty - 10-14" P.Z.

This site is associated with the Fergus soils on bottomlands, low terraces and valley fans. It occupies about 20 percent of the non-cultivated land within the soil association.

The native plant cover is primarily grasses with a variety of forbs along with scattered plants of silver and big sagebrush. Dominant species are western wheatgrass, needleandthread, blue grama, and sedges. Scattered ponderosa pines grow in the more favorable portions of the site.

This site is important habitat for deer, antelope, and upland game birds.

When in excellent condition, it produces from 900 to 1,700 pounds per acre.

It is estimated that the present condition of the rangelands in this association is as follows:

15 percent - Excellent
30 percent - Good
50 percent - Fair
5 percent - Poor

Lands within this association are in Burke, McLean, Mountrail, Sheridan, and Ward Counties, North Dakota. This area is considered to be represented by the Central Vegetative Zone.

Range Sites:

A. Silty - Central V.Z.

About 75 percent of the non-cultivated lands within the association are in the Silty range site. The most common soils are Williams and Barnes.

This is naturally a very productive grassland plant community. It is dominated by cool-season species, but has a good mixture of both cool- and warm-season kinds. Major species include green needlegrass, western wheatgrass, needleandthread, prairie junegrass, blue grama, big and little bluestems and both slender and bearded wheatgrasses. A wide variety of forbs makes up 10 percent or more of the normal plant mixture and include stiff sunflower, purple prairieclover, breadroot scurfpea, dotted gayfeather, and blacksamson. The few scattered woody plants are mostly fringed sagebrush, western snowberry, and prairie rose.

When the site is subjected to prolonged misuse, the taller growing plants die out and are replaced by blue grama, fringed sagebrush and sedges.

When in excellent condition, this site produces an average of over 2,100 pounds per acre of air-dry vegetation. Plot clippings indicate production may be as low as 1,200 pounds during very unfavorable years and may be over 2,200 pounds per acre during good years.

This is a favorable site for upland birds.

B. Thin Uplands - Central V.Z.

Approximately 25 percent of the rangeland falls within the Thin Upland range site. This is mostly the Buse soil series.

The natural vegetation is mostly grass of good variety. Common species are little bluestem, needleandthread grass, sideoats grama, and green needlegrass with smaller amounts of blue grama, western wheatgrass, and plains muhly. There are several low-growing sedges which are prominent but never dominant in the natural cover. Stiff sunflower, blacksamson, silverleaf scurfpea, and dotted gayfeather are common forbs. Scattered patches of prairie rose, buffaloberry and chokecherry grow in the small coulees.

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With mismanagement, the taller grasses are replaced by thickened stands of sedge and blue grama and by low-quality weeds.

Annual production has been observed to range between 800 and 2,000 pounds per acre per year. Average production is about 1,600 pounds per acre.

This is a favorable wildlife habitat for upland birds and, to a limited extent, for deer.

It has been estimated that the present condition of rangelands within this soil association is:

40 percent - Excellent
50 percent - Good
10 percent - Fair

This soil association occurs in Dawson, McCone Prairie, Richland, and Wibaux Counties in Montana and in Billings and Golden Valley Counties in adjacent North Dakota.

Range Sites:

Silty - 10-14" P.Z.

With the exception of very small inclusions, all the non-cultivated lands in this association fall within the Silty -10-14" P.Z. range site. Shambo, Lambert and Cherry soils are representative. There is a tendency for the Shambo soils to have slightly better moisture relationships than the other named soils and, for that reason, production on that soil is usually somewhat higher than on Lambert and Cherry soils.

Dominant species in the native plant community are needleandthread, little bluestem, western wheatgrass and bluebunch wheatgrass. There are smaller amounts of blue grama and sedges. Forbs are not abundant. There usually is a widely scattered showing of silver and big sagebrush, especially on the more favorable portions of the site.

The site is useful for mule deer, antelope and upland game birds.

When in excellent condition, this site produces from 900 to 1,600 pounds per acre per year.

It is estimated that the present range condition is:

20 percent - Excellent
35 percent - Good
45 percent - Fair

This soil association is in the northeastern corner of Montana and occupies parts of Daniels, McCone, and Valley Counties.

Range Sites:

Silty - 10-14" P.Z.

Except for a few minor inclusions, all the non-cultivated lands within the association fall within the Silty - 10-14" P.Z. range site. The most common soils are the Lambert and the Williams.

The natural plant community is dominated by little bluestem, needleandthread, and western wheatgrass. There are smaller amounts of blue grama, sedges and forbs. Big sagebrush may occur as widely scattered plants.

The site is used, at least seasonally, by mule deer, sharptail and sage grouse, pheasants and Hungarian partridge.

In excellent condition, production ranges from 900 to 1,300 pounds per acre per year.

Present range condition is estimated as:

15 percent - Excellent
30 percent - Good
55 percent - Fair

This soil association includes a very large total area. Most of the association within the NGPRP is in northwestern North Dakota although it also occurs in four counties in Montana and one county in South Dakota. Considerable variation in plant communities may be expected within an area as geographically broad as this soil association. Recognizing that there are several inclusions of minor amounts of quite different range sites, the following are considered as being most representative of the majority of the soils within the association:

Range Sites:

A. Shallow - Missouri Slope V.Z.

An estimated 65 percent of the non-cultivated land within this association falls within the Shallow range site of the Missouri slope vegetative zone. The Cabba soil series typifies this range site.

The potential plant community is dominated by mid-grasses. Prominent species are western wheatgrass, needleandthread grass, and green needlegrass. Blue grama usually makes up an appreciable amount of the cover also. Other common grasses are prairie junegrass and sandberg bluegrass. Penn sedge, threadleaf sedge and needleleaf sedge are commonly associated with the shorter grasses. Forbs typically contribute about 10 percent of the plant cover and include such species as heath aster, prairie coneflower, green sagewort, scarlet globemallow, and purple prairieclover. The few, usually scattered woody plants are prairie rose, western snowberry, silver sagebrush, fringed sagebrush and, occasionally, winterfat.

Following continued heavy grazing use, the plant cover becomes dominated by blue grama, sedges and weeds with very low productivity.

When in excellent condtiion, this site produced from 1,650 to 2,250 pounds per acre with an average production of about 1,950 pounds.

The site has value for antelope, deer, upland game birds such as the sharp-tailed grouse, and lesser small birds and mammals.

B. Silty - Missouri Slope V.Z.

The Silty range site occurs typically on the Morton soils which have not been cultivated. Nearly 35 percent of the rangeland within the association is in the Silty range site.

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The site is naturally dominated by a mixture of cool- and warm-season mid-grasses. Prominent are western wheatgrass, needleandthread grass, little bluestem and prairie reedgrass. Others include plains muhly, sideoats and blue grama, and a variety of sedges. Forbs are scattered throughout and, though they contribute only about 10 percent of the production, they add variety and color. Common forbs are blacksamson, hairy goldaster, skeletonweed, purple prairieclover, dotted gayfeather, and stiff sunflower. Fringed sagewort, winterfat, western snowberry and shrubby cinquefoil are the major woody species although there are frequently small patches of buffalo brush and juniper in the pockets and small depressions.

Following continued misuse, the more palatable and productive mid-grasses are replaced by blue grama, sedges and weedy plants.

Average annual production on this site is about 1,400 pounds per acre but it varies from year to year from 1,150 to 1,650 pounds.

The site has moderately high value as habitat for antelope, deer, upland game birds and associated wildlife species.

For the association as a whole, it has been estimated that the present condition of the rangelands is:

40 percent - Excellent
50 percent - Good
10 percent - Fair

This soil association is entirely within Valley County, Montana. A large percentage of the soils are used as cropland.

Range Sites:

Clayey - 10-14" P.Z.

Except for very minor inclusions, all the rangeland portion of this association falls within the Clayey -10-14" P.Z. range site. Major soils represented are Scobey, Phillips, and Elloam.

The potential plant community is mostly cool-season grasses. Most important species are western wheatgrass, needleandthread, and prairie junegrass. There is a good variety of forbs, including several legumes. Scattered sagebrush plants are commonly associated with this plant community.

The area is used by mule deer, antelope, and upland game birds.

Production, in excellent condition, ranges from 900 to 1,300 pounds per acre per year.

Present range condition is estimated to be:

5 percent - Excellent
40 percent - Good
50 percent - Fair
5 percent - Poor

Soil Association No. 41

This association is in Garfield, Rosebud, Treasure, and Valley Counties within the NGPRP area in Montana.

Range Sites:

A. Clayey - 10-14" P.Z.

This range site makes up approximately 50 percent of the non-cultivated land within soil association No. 41. It occurs primarily on the Thebo soils.

The natural plant community is dominated by western wheatgrass and green needlegrass, along with smaller amounts of prairie junegrass, blue grama, and a wide variety of forbs. Scattered big sagebrush plants are usually present.

When in excellent condition, this range site produces from 900 to 1,300 pounds per acre, depending on how favorable the growing season has been.

It has values as habitat for mule deer, antelope and sage grouse.

B. Shallow Clay - 10-14" P.Z.

This range site is associated with the Lisam soils. It occupies about half the non-cultivated land in the association.

This range site normally supports a widely-spaced stand of ponderosa pine and juniper with an understory of grasses, forbs and a few shrubs. The major part of the production is provided by western and bluebunch wheatgrasses, green needlegrass and prairie june grass. Nuttall saltbush and big sagebrush are the most common woody plants.

Because of the scattered trees plus the shrub and forb growth, this site is valuable habitat for deer, antelope, sage grouse and wild turkey.

When in excellent condition, total production varies from 600 to 900 pounds per acre per year.

It has been estimated that the present condition of the rangeland within this association is:

5 percent - Excellent
25 percent - Good
65 percent - Fair
5 percent - Poor

The small area within this association is entirely within Valley County, Montana.

Range Sites:

The two major soils within the association, Pendroy and Scobey produce similar enough native vegetation in this low rainfall area that they are both included in the same range site.

A. Clayey - 10-14" P.Z.

Dominant species in the natural plant community are western wheatgrass, green needlegrass, and prairie junegrass. There are usually several other grasses in smaller amounts. Perennial forbs are prominent and are represented by several species. Scattered big sagebrush plants are normal.

The site is used, at least seasonally, by elk, mule deer, whitetail deer, antelope, pheasants and Hungarian partridge.

When in excellent condition, the site produces from 900 to 1,300 pounds per acre per year.

It is estimated that the present condition of the rangelands in this association is:

5 percent - Excellent
25 percent - Good
65 percent - Fair
5 percent - Poor

This soil association occurs in Meade, Perkins, and Ziebach Counties in South Dakota.

Range Sites:

Because of significant differences in the major soils, there are three important range sites within this soil association:

A. Thin Claypan - Western

This site makes up about 30 percent of the rangeland within the association and occurs primarily on the Absher soils.

The natural plant community for this site is dominated by short grasses. Blue grama or buffalograss or the two in mixture usually make up two-thirds or more of the plant cover. Western wheatgrass is the major cool season grass and is present if the area is properly managed. There are few forbs and only small amounts of pricklypear and sagebrush.

The approximate total annual air-dry production of the site, when in excellent condition, is 700 pounds per acre, but this varies from 500 pounds during unfavorable years to about 900 during favorable years.

B. Shallow - Western

This site occurs on the Cabbart soils. It makes up about 30 percent of the rangeland within the association.

The potential plant community for this site is a mixture of mid-grasses along with some short grass and small amounts of woody plants and forbs.

Little bluestem is the most abundant species when the plant community is intact, needleandthread grass and sideoats grama are important in the mixture. The major woody species are skunkbush sumac, leadplant and rose.

When the site is misused, little bluestem is replaced by sideoats grama which, if misuse is severe, may be replaced by sedges and by thin stands of blue grama.

When the site is in excellent condition, production ranges from 1200 to 1700 pounds per acre per year. The long-time average is about 1400 pounds per acre per year.

This is a preferred site for antelope.

C. Silty - Western

This site occurs mostly on the Marmarth soils and makes up about 30 percent of the rangeland in the soil association.

Western wheatgrass, green needlegrass, and needleandthread grass dominate the natural plant community. There are normally smaller amounts of blue grama, buffalograss and sedges. Fringed sagewort, pricklypear and sagebrush occur as scattered individual plants or small clumps.

If subjected to continued over use, the mid-grasses are replaced by blue grama, buffalograss and sedge. In severe depletion, the cover is usually pricklypear, fringed sagewort and weeds.

The site is capable of producing up to 2,100 pounds per acre during favorable years and average production is about 1,800 pounds per acre.

It is estimated that the present condition of the rangelands of the three range sites within soil association No. 43 is currently as follows:

20 percent Excellent
60 percent Good
20 percent Fair

A very large area (over 12,000 square miles) is included in this soil association. It includes parts of Carter, Custer, Dawson, Fallon, Garfield, McCone, Prairie, Rosebud, and Wibaux Counties in Montana and portions of Bowman, Butte, Harding, Meade, and Perkins Counties in South Dakota.

Range Sites:

As to be expected within an area as large as that delineated in this soil association, there are many differences in soils and climate which may be rather important on a local farm or ranch basis but which are too small to include as significant parts of the association as a whole. It is recognized, therefore, that the range sites described below represent those which most nearly characterize the major part of the association.

A. Silty - 10-14" P.Z.

About three-fourths of the non-cultivated land within the association is in the Silty - 10-14" P.Z. range site. It is associated with the Lambeth and Yamac soils.

This is primarily a grassland. Dominant species are needleandthread grass and western wheatgrass. There are smaller amounts of little bluestem, blue grama, and a few sedges. Several forbs are important, including native legumes. A thin, scattered showing of big sagebrush is normal.

The site is used by mule deer, antelope and upland game birds.

When in excellent condition, the site produces from 900 to 1,300 pounds per acre, depending upon amount and distribution of precipitation.

B. Dense Clay - 10-14" P.Z.

This site occurs mostly on the Absher soils. It makes up about 20 percent of the non-cultivated soils.

This low-producing site naturally supports a mixed stand of grasses and low shrubs. Major grasses include western wheatgrass, green needlegrass, Sandberg bluegrass, inland saltgrass, and squirreltail. There is usually a small amount of forbs. Scattered plants or small colonies of greasewood, Nuttall's saltbush and big sagebrush are normal to the site.

The site is used, at least seasonally, by deer, antelope and upland birds.

When in excellent condition, the site produces from 500 to 900 pounds per acre in this low rainfall zone.

It is estimated that the rangelands in this association are presently in the following condition:

20 percent - Excellent
35 percent - Good
40 percent - Fair
5 percent - Poor

This soil association occurs in Dewey, Corson and Ziebach Counties, South Dakota.

Range Sites:

The soil association includes a rather wide variation in soils. For this reason, three significant range sites are recognized as follows:

A. Clayey - West Central

This site makes up about 25 percent of the non-cultivated land within the association and most commonly occurs on the Opal and Promise soils.

The natural plant cover is chiefly a mixture of green needlegrass and western wheatgrass. There are smaller amounts of short grasses and relatively few forbs or woody plants.

Following continued overuse, the green needlegrass is usually replaced by western wheatgrass. Severe overuse is marked by a general increase in blue grama, buffalograss, sedges and forbs.

When in excellent condition, this site produces from 1,500 to 2,000 pounds per acre per year. The average production is about 2,000 pounds per acre.

Because of the lack of forbs and woody plants, the site has limited value for wildlife.

B. Shallow - West Central

This site occurs on the Sansarc soils and makes up about 65 percent of the rangeland within the soil association.

The natural plant cover is dominated by little bluestem. Sideoats grama, blue and hairy grama and needleandthread grass also make up a significant amount of the cover. Desirable forbs, such as blacksamson, and such woody plants as skunkbush sumac, leadplant and rose are common though not abundant.

When subjected to overuse, the little bluestem is replaced by grama grasses and needleandthread grass. The site is subject to severe erosion if heavy use is continuous.

In excellent condition, production varies from 1,300 to 1,600 pounds per acre and averages about 1,600 pounds per acre.

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C. Dense Clay - West Central

This site occurs primarily on the Dupree soils and makes up only about 10 percent of the rangeland in the association. It is included mostly because of differences in vegetation.

The natural plant community is mainly western wheatgrass and green needlegrass which, together, may make up 90 percent or more of the composition. It does not have an understory of short grasses. There are a few scattered forbs and a small amount of pricklypear.

When abused, the green needlegrass is lost. If misuse continues, the western wheatgrass thins out and is replaced by weedy plants.

When the cover is in excellent condition, production ranges from as low as 900 pounds per acre to over 1,800. Average production is about 1,500 pounds per acre per year.

It is estimated that the present range condition of the grazing lands within this soil association is:

40 percent - Excellent
50 percent - Good
10 percent - Fair

All of this soil association within the NGPRP area lies within Converse and Natrona Counties, Wyoming.

Range Sites: There are two significant range sites as follows:

A. Loamy - 15-19 Foothills and Mountains, Southeast

This site makes up about 70 percent of the rangeland and includes the Chushman, Kim and Alcova soils.

The natural plant community for this site is largely a wide mixture of grasses but with prominent amounts of forbs and some woody plants. Most important grasses are bluebunch wheatgrass, Idaho fescue, Griffith wheatgrass and prairie junegrass. Important forbs include penstemon, native clovers, mallow, paintbrushes and yarrow. Scattered stands of winterfat are common and there is usually a small amount of big and three-tip sagebrush and low rabbitbrush.

Big sagebrush and rabbitbrush increase significantly when condition declines.

Total annual yield ranges from 800 to 2,000 pounds per acre and averages around 1,500 pounds.

The site is extremely valuable for antelope and mule deer because of the high quality forbs and the browse it usually grows.

At present, it is estimated that 20 percent of the site within these two counties is in excellent condition, 40 percent in good; 40 percent in fair; and that none is presently in poor condition.

B. Shallow Loamy - 15-19, Foothills and Mountains, Southeast

This site occurs mostly on the Shingle soils and is often intermingled with the Loamy site described above. It makes up an estimated 30 percent of the rangeland within Association No. 91.

The natural plant community on this site varies from that of the Loamy site mostly because of lower productivity. It also has a somewhat higher proportion of woody plants, including bitterbrush, mountain mahogany, and black sagebrush--all valuable browse plants for antelope and deer as well as for domestic livestock. Bluebunch wheatgrass is the dominant grass but Idaho fescue, Griffith wheatgrass and slimstem muhly are also common.

Estimated production of the site when in excellent condition ranges from 800 pounds per acre during dry years to over 1,400 during favorable years. The average production is estimated to be about 1,100 pounds per acre.

91 Continued

Note:

In addition to the two range sites described above, portions of this Association are occupied by woodland soils which support such woody species as ponderosa and lodgepole pine, Douglas fir, alpine fir, aspen and a variety of large shrubs.

The Association, as a whole, has very high wildlife, scenery and recreation values.

All of this soil association within the NGPRP area is within Niobrara and Converse Counties, Wyoming.

Range Sites: There are two significant range sites as follows:

A. Sandy 15-17, Southern Plains

This site includes the Alice and Vetal soils and makes up about 60 percent of the rangeland within the association area.

The natural plant community for the Sandy site is about 80 percent grass, with a good variety of forbs and small, but important amounts of woody plants including fourwing saltbush, winterfat and silver sagebrush.

Prominent grasses are needleandthread, prairie sandreed, western wheatgrass and blue grama. Little bluestem, sand bluestem, sideoats grama and indian ricegrass frequently occur in small amount if the area has been very carefully grazed. Under misuse, blue grama and threadleaf sedge become dominant.

Annual production varies from 800 to 1,900 pounds per acre with about 1,400 pounds per acre being about typical for an average year.

Estimates of present condition within this site are:

20 percent Excellent
40 percent Good
35 percent Fair
5 percent Poor

B. Sands 15-17, Southern Plains

This site makes up most of the other 40 percent of the rangeland in Soil Association 94, and occurs on the Valent Soils.

This is primarily a grassland with very few forbs or woody plants when the plant community is in high condition. It differs from the Sandy site primarily in being dominated by deep-rooted grasses typical of the deep sand soils. These include sand bluestem, little bluestem, prairie sandreed, sand dropseed, needleandthread and, occasionally, blowout grass. Blue grama and sageworts increase along with sand sagebrush when the cover is disturbed by improper use.

This site is subject to severe wind erosion when cover is depleted.

Production ranges from 900 to 2,000 pounds per acre with an annual average of about 1,500 pounds per acre.

At present, it is estimated that the land within this range site is about 25 percent in excellent condition; 40 percent good; 30 percent fair; and 5 percent in poor condition.

Both these sites have fair to good wildlife habitat values.

Within the area covered by the NGPRP, this soil association occurs mostly in Meade County, South Dakota with a small amount also in neighboring Butte County.

Range Sites:

The two major range sites within this soil association are:

A. Clayey - Western

This is the most common range site and makes up nearly three-fourths of the non-cultivated portion of the association. Typical soils upon which it occurs are Caputa and Pierre.

The natural plant community is almost entirely grass. Western wheatgrass and green needlegrass are the two dominant species and they normally grow with a thin understory of blue grama and buffalograss. Forbs and shrubs are not common although the amount of big sagebrush is slightly more in the western part of the site.

With overuse, the western wheatgrass and green needlegrass give way to a turf of buffalograss and blue grama. In severe depletion, pricklypear and weeds usually dominate.

When in excellent condition, the site produces from 1,500 to 2,000 pounds per acre. Average annual production is about 1,700 pounds per acre.

B. Shallow - Western

This site, making up about 25 percent of the rangeland within the association, occurs commonly on the Samsil soils.

The potential plant community is a mixture of mid-grasses along with some short grasses and small amounts of woody plants and forbs.

Little bluestem is the most abundant species when the plant community is intact. Needleandthread grass and sideoats grama are also important. The main woody plants are skunkbush sumac, leadplant and rose.

Following continued misuse, little bluestem is replaced by sideoats grama and it, in turn, by thin stands of blue grama.

99 Continued

When in excellent condition, production ranges from 1,200 to 1,700 pounds per acre per year. The long-time average is about 1,400 pounds per acre.

This is a preferred site for antelope.

(Note: Small amounts of Silty and Shallow Dense Clay range sites also occur in this association, but the amounts are insignificant to this inventory.)

It is estimated that the present condition of the rangelands within this association is:

20 percent - Excellent
60 percent - Good
20 percent - Poor

All of this soil association area within the NGPRP area lies within Niobrara County, Wyoming.

Range sites: There are two significant range sites as follows:

A. Loamy 15-17, Southern Plains

This includes the Colby, Mitchell and Rosebud soils and comprises about 80 percent of the non-cultivated portion of the association.

The natural plant community is primarily grass with needleandthread, western wheatgrass, blue grama and threadleaf sedge being most common. The site normally supports moderate amounts of a wide variety of forbs and widely scattered big sagebrush.

With continued misuse, blue grama and threadleaf sedge usually increase.

When in excellent condition, this site produces from 700 pounds per acres in unfavorable years to 1,900 pounds per acre during the most favorable years. Long-time average production is about 1,400 pounds.

It is estimated that about 20 percent of the land in this site in Association No. 101 is in excellent condition; 40 percent in good condition; 35 percent in fair condition; and only 5 percent in poor condition.

The site is used mostly during spring, summer and fall by cattle and sheep. It also supports antelope and other wildlife.

B. Shallow Loamy 15-17, Southern Plains

This site occurs primarily on the Epping soils.

The natural cover is essentially grassland. Little bluestem is common, along with bluebunch wheatgrass, blue grama, threadleaf sedge and small amounts of a mixture of forbs. The site also normally supports small patches of mountain mahogany and yucca. Scattered ponderosa pine occurs along a narrow stony ridge which extends through this site.

Sedge and blue grama tend to increase at the expense of taller grasses as a result of continued grazing misuse.

When in excellent condition, production on this site ranges from 600 to 1,400 pounds per acre with an average of about 1,000 pounds per acre.

The present condition of the site is estimated at 25 percent excellent; 35 percent good; 35 percent fair; and 5 percent poor.

This site is a valuable wintering area for both deer and antelope.

All of this soil association within the NGPRP area occurs in Niobrara County, Wyoming.

Range Sites: There are two major range sites within the area:

A. Loamy 15-17, Southern Plains

This site includes the Santata soils and makes up about 50 percent of the rangeland within the mapping unit.

The natural plant community is primarily grass with needleandthread, western wheatgrass, blue grama and threadleaf sedge being most common. The site normally supports moderate amounts of a wide variety of forbs and widely scattered big sagebrush.

With continued misuse, blue grama and threadleaf sedge usually increase.

When in excellent condition, this site produces from 700 pounds per acres in unfavorable years to 1,900 pounds per acre during the most favorable years. Long-time average production is about 1,400 pounds.

It is estimated that about 20 percent of the land in this site in Association No. 101 is in excellent condition; 40 percent in good condition; 35 percent in fair condition; and only 5 percent in poor condition.

The site is used mostly during spring, summer and fall by cattle and sheep. It also supports antelope and other wildlife.

B. Shallow Loamy 15-17, Southern Plains

This site occurs on the Tassel and Trelona soils. It, also, makes up about half the rangeland within the mapping unit.

The natural cover is essentially grassland. Little bluestem is common, along with bluebunch wheatgrass, blue grama, threadleaf sedge and small amounts of a mixture of forbs. The site also normally supports small patches of mountain mahogany and yucca. Scattered ponderosa pine occurs along a narrow stony ridge which extends through this site.

Sedge and blue grama tend to increase at the expense of taller grasses as a result of continued grazing misuse.

When in excellent condition, production on this site ranges from 600 to 1,400 pounds per acre with an average of about 1,000 pounds per acre.

The present condition of the site is estimated at 25 percent excellent; 35 percent good; 35 percent fair; and 5 percent poor.

This site is a valuable wintering area for both deer and antelope.

This association occurs mostly in Meade County, South Dakota, but with a small amount in nearby Ziebach County.

This soil association includes soils which differ sufficiently that several distinct range sites occur. The more important ones are:

A. Silty- Western

This is primarily on the Marmarth soils and makes up about half the non-cultivated land in the association.

The natural plant community for the site is dominated by western wheatgrass, green needlegrass and needleandthread grass. There are smaller amounts of blue grama, buffalograss and sedges. Fringed sagewort, pricklypear and big sagebrush occur as scattered individual plants or small clumps.

If subjected to continued overuse, the mid-grasses are replaced by blue grama, buffalograss and sedge. In severe depletion, the cover is usually pricklypear, fringed sagewort and weeds.

When in excellent condition, the site produces from 1,600 to 2,000 pounds per acre and averages about 1,800 pounds.

B. Shallow - Western

This range site is typical of the Cabbart soils. It makes up about 25 percent of the rangeland within the association.

The natural plant community of the site is a mixture of mid-grasses along with some short grasses and small amounts of woody plants and forbs.

Little bluestem is the most abundant species when the plant community is intact, but needleandthread grass and sideoats grama are also important. Skunkbush, leadplant and rose are the more common woody plants.

Under misuse, little bluestem is replaced by sideoats grama. If misuse is severe, the sideoats is replaced by sedges and by thin stands of blue grama.

When in excellent condition, this side produces from 1,200 to 1,700 pounds per acre per year with an average of about 1,400 pounds.

This is a preferred site for antelope.

C. Clayey - Western

This site occurs mostly on the Kyle and Pierre soils. It makes up about 15 percent of the rangeland in the association.

The potential plant cover is almost entirely grass. Western wheatgrass and green needlegrass are the two dominant species and they normally grow with a thin understory of blue grama and buffalograss. Forbs and shrubs are not common.

With overuse, the western wheatgrass and green needlegrass give way to a turf of buffalograss and blue grama. In severe depletion, pricklypear and weeds usually dominate.

When in excellent condition, the site produces from 1,500 to 2,000 pounds per acre. Average annual production is about 1,700 pounds per acre.

D. Sandy - Western

This site occurs mostly on the Twilight soils. It makes up about 10 percent of the non-cultivated portion of the soil association and is included here because the natural plant community is significantly different than that of the other range sites within the association.

The potential plant community consists chiefly of a mixture of mid- and tall grasses. Prairie sandreed, sand bluestem and little bluestem are the most common and abundant species, although the cool-season western wheatgrass and needleandthread grass are important. Sand sagebrush is scattered and is most common in the southern part of the area where the site occurs.

When subjected to continued excessive use, the bluestem and prairie sandreed are replaced by the cool season species. In severe depletion, sand dropseed, threadleaf sedge and bluegrama become prominent. Green sagewort and annual forbs are common weedy plants.

When in excellent condition, this site produces from 1,600 to 2,200 pounds per acre. Average annual production is about 1,900 pounds per acre.

It is currently estimated that the rangelands within soil association No. 109 fall within the following condition classes:

20 percent - Excellent
60 percent - Good
20 percent - Fair

This soil association occurs in Bighorn, Rosebud, and Treasure Counties, Montana.

Range Sites:

Much of the association is in cultivation.

A. Silty - 10-14" P.Z.

With the exception of a few scattered minor inclusions, all the non-cultivated land falls within the Silty - 10-14" P.Z. range site. The most common soils are the Wanetta and Haverson.

The natural plant community is dominated by bluebunch wheatgrass and needleandthread. Western wheatgrass, prairie junegrass and blue grama also occur. There are several native legumes among the forbs. A widely scattered stand of big sagebrush is not uncommon.

Narrow strips of cottonwoods and other riparian vegetation occur along streambanks.

When in excellent condition, the site produces from 900 to 1,300 pounds per acre -- variations are caused largely by differences in amounts and distribution of precipitation from year to year.

The site is used, at least seasonally, by mule and whitetail deer, antelope, and upland game birds.

It is estimated that the present condition of the rangelands is:

5 percent - Excellent
20 percent - Good
65 percent - Fair
10 percent - Poor

Occurs in Natrona and Converse Counties, Wyoming.

Range Site: Sands 10-14" P.Z.

The natural plant community for this site is dominated by mid- and tall grasses. Prairie sandreed, needleandthread grass and sand bluestem are important. Forbs occur in wide variety. There are small amounts of silver sagebrush and rubber rabbitbrush.

When condition deteriorates, taller grasses are usually replaced by short grasses including hairy grama, sand dropseed, threadleaf sedge and by weedy forbs.

When in excellent condition, the total production ranges from 1,400 to 2,500 pounds per acre and averages about 2,000 pounds per acre.

At present, it is estimated that 20 percent of the land in this site is in excellent condition; 35 percent in good condition; 40 percent in fair; and 5 percent in poor condition.

The site has very high value for pronghorn antelope. The counties in which the sites occur are said to have the highest antelope population in Wyoming.

This site is normally grasses yearlong by sheep and cattle.

This soil association extends over a rather wide latitude within the NGPRP. There is much variation among the individual soils as well as in minor differences in climatic influences within this large and heterogeneous delineation. In Montana, it occurs in Carter, Custer, Dawson, Fallon, Garfield, Prairie, Valley, and Wibaux Counties. In North Dakota, it is in Billings, Bowman, Dunn, Golden Valley, McKenzie, and Slope Counties. A large area of this same association in South Dakota is outside the boundaries of the NGPRP.

Range Sites:

Within an area so large and with such diverse soils and micro-climate, it must be recognized that several range sites are not extensive enough to be considered as characteristic of the association even though locally they may be very important. The following treatment is based on the technical guides currently in use in Montana.

A. Shale Outcrop - 10-14" P.Z.

This site makes up only about 10 percent of the non-cultivated area. It is naturally unstable and nearly barren. It is perhaps the only true "badlands" within the association. It has limited use for wildlife habitat.

B. Badlands - 10-14" P.Z.

About 10 percent of the area is classed as the "badlands" range site. It usually occurs on areas where the soil is considered a badlands miscellaneous land type. Characteristically, areas of productive soil are interspersed with smaller, unstable lands.

The natural plant community for the vegetated portions normally includes a wide variety of plant species including grasses, forbs and shrubs. Most abundant species are western wheatgrass, little bluestem, prairie sandreed, bluebunch wheatgrass, and blue grama. Among woody plants scattered throughout are Nuttall's saltbush, skunkbush sumac, shadscale, greasewood, and big sagebrush. Occasional junipers dot the landscape.

The site provides excellent habitat for mule deer and upland birds.

Production varies considerably, but on the average ranges from 800 to 1,100 pounds per acre.

C. Thin Hilly - 10-14" P.Z.

This site occurs on Lambert soils and makes up about 30 percent of the non-cultivated land in the association.

Plants characteristic of the native plant community are little bluestem, needleandthread, western wheatgrass, sideoats grama, prairie sandreed, blue grama and sedges. Big sagebrush and skunkbush sumac are scattered throughout. The site sometimes grows widely scattered small ponderosa pine.

This site is also useful as habitat for big game and upland birds.

D. Shallow Clay - 10-14" P.Z.

Typical of the Lismus soils is the Shallow Clay - 10-14" P.Z. range site. It makes up about 30 percent of the non-cultivated area.

The potential plant community for this site includes many species of good variety. Major, on the basis of productivity, are bluebunch wheatgrass, western wheatgrass, green needlegrass, little bluestem, and prairie junegrass. Nuttall's saltbush and big sagebrush are scattered, along with a few ponderosa pines and some juniper.

The site has a very high potential as wildlife habitat.

E. Clayey - 10-14" P.Z. (10 percent) on Harlem soils
Dense Clay - 10-14" P.Z. (5 percent) on Vanda soils
Saline Upland - 10-14" P.Z. (5 percent) on Nobe soils

These range sites collectively make up about 20 percent of the rangeland within the association. The Dense Clay-10-14" P.Z. and Saline Upland-10-14" P.Z. sites are somewhat different than others in the association because of the place of several plant species usually associated with salinity. For example, alkali sacaton, squirreltail, inland saltgrass, greasewood, and Nuttall's saltbush are present in varying amounts.

All these sites have value as wildlife habitat and much of the Missouri River breaks area is noted for fine wildlife populations.

For the Montana portions of soil association No. 184, it is estimated that the present range condition is:

20 percent - Excellent
40 percent - Good
35 percent - Fair
5 percent - Poor

184 Continued

Note: The North Dakota portion of this soil association is somewhat different vegetatively than the Montana portion.

In the North Dakota portion it is estimated that about 30 percent of the area is more or less barren raw shale or true badland. This is often intimately intermingled with areas of other range sites. The barren portions are usually on west and south exposures. Of the remaining portion of the association in North Dakota, the following range sites are prominent:

Shallow - making up about 50 percent of the area

(Silty
(Overflow - together making up about 20 percent
(Clayey

The North Dakota portion of association No. 184 is estimated to be presently in the following range condition:

40 percent - Excellent
45 percent - Good
10 percent - Fair
5 percent - Poor

The Black Hills soil association within the NGPRP occurs in Crook County, Wyoming and Meade County, South Dakota. Additonal acreages of this association occur outside the NGPRP.

It is estimated that approximately 50 percent of the non-cultivated portions of the Black Hills soil association area is forest. The remainder, including open parks within the forests as well as rangeland which may have open, sparse stands of trees is considered as non-forest grazing land.

Range Sites:

The following applies only to those non-cultivated portions of the association not considered to be forest:

A. Loamy - 15-19 - B.H.Z. (Black Hills Zone)

This site occurs on such soils as Santana and Key. It makes up about 60 percent of the non-forested portion of the association.

The natural plant community is dominated by mid-grasses. Most common species include green needlegrass, Columbia needlegrass, western wheatgrass, needleandthread grass and several others of lesser importance. There is a variety of upland sedges. Forbs are important and make up about 15 percent of the plant community. Important kinds are biscuitroot, silverleaf scurfpea, eriogonum and fringed sagewort. Widely scattered plants of big sagebrush are normal to the site.

When range condition deteriorates, blue grama, fringed sagewort and weeds become abundant at the expense of the better grasses.

Approximate total annual production of the site in excellent condition averages about 2,200 pounds per acre but it will vary from 1,500 to 3,000 in poor or favorable years.

B. Shallow Loamy - 15-19 - B.H.Z

This site is associated with the Shingle soils. It makes up about 40 percent of the non-wooded land in the association.

The potential plant community is also dominated by mid-grasses such as little bluestem, bluebunch wheatgrass, spike fescue, western wheatgrass, and needleandthread. Blue grama and threadleaf sedge are prominent but not dominant unless the site is subjected to continued misuse. There is a good variety of forbs but only a few scattered shrubs such as skunkbush sumac.

Average annual production in excellent condition is 1,400 pounds per acre. This can be expected to vary from year to year from 900 to 1,800 pounds, depending on the kind of growing season.

It is estimated that the present condition of these two range sites is:

25 percent - Excellent
45 percent - Good
30 percent - Fair

Discussion draft
February 1974

FISH AND WILDLIFE

I. INTRODUCTION

This regional profile for fish and wildlife resources was prepared by the Fish and Wildlife Subgroup. The objective of this report is to highlight the nature and scope of the fish and wildlife resources within the study-area portions of Montana, North Dakota, South Dakota, and Wyoming. This includes indicating their importance in terms of general distribution and quality of habitat, current populations and trends, and consumptive and nonconsumptive uses. Such information comprises the initial, broad index of these resources' importance, against which the probable impact of other resource development--at various levels and at different points in time--can be gaged.

II. PROCEDURES

Because of the restrictive time frame for report preparation, some basic fish and wildlife information was derived from the Missouri River Basin Comprehensive Framework Study (1971). The applicable Missouri River Basin Comprehensive Framework Study analyses were: (1) Upper Missouri River Tributaries Subbasin; (2) Yellowstone River Subbasin; and (3) Western Dakota Tributaries Subbasin.

Almost all of the information contained in the above series of reports was updated by discussions between subgroup biologists and State fish and game biologists of the respective districts within the study area. New distribution maps were prepared for a representative group of 19 wildlife species, in cooperation with the appropriate State biologists, together with a map showing sites of lands managed for fish and wildlife by both State Fish and Game Departments and the Bureau of Sport Fisheries and Wildlife (See Appendix, this report).

Information on species distribution and habitat quality has been amalgamated into a study-wide map (portions of four states) for each species on a 1:1,000,000 scale. The narrative portion is presented by states. This approach facilitates ease of reference and reflects individual variations among the states as to game status, management

objectives, and the like.

The wildlife habitat maps, prepared at a 1:1,000,000 scale, do not provide detail required for site-specific analyses of developmental impacts such as plant sitings, strip mine locations, power corridors, suburban expansion, highway and railroad and pipeline rights-of-way, fencing, impoundment sites, and the like. Where more precise information is called for, more detailed mapping may be required following actual onsite inspection of the areas being considered for development.

III. RESULTS

Extensive portions of the Northern Great Plains Resource Program area are nationally known and important for their outstanding game hunting for deer, antelope, elk, and prairie grouse. Limited hunting for prime trophy species of bear, moose, mountain goat, and bighorn sheep occurs in several more restricted locales within the area. There is also a wide variety of upland game birds and animals. Relatively low hunting pressures provide sportsmen with an array of opportunities unequaled almost anywhere in the nation. Waterfowl resources are locally important, and extensive natural wetlands are present--especially in the northern portion of the study area. In some areas, waterfowl resources are limited by a lack of natural wetlands or developed facilities, and waterfowl hunting is of little importance. Overall, the area is recognized not only as one important for game production and hunting, but one that affords many opportunities for observation or other nonconsumptive use of an even wider range of native and introduced species. These resources are a source of appreciable income, and provide many thousands of days of recreation for both resident and nonresident participants. For these reasons, wildlife species should not be overlooked in formulating development plans; and every effort should be made to safeguard this potential.

The Northern Great Plains Resource Program area contains many miles of fishing streams, of which a substantial number of segments are classified as Class 1 of national importance or Class 2 of statewide importance. Although these and other streams currently

support an impressive amount of use, the bulk of existing fishing capacity is afforded by the variety of lakes, reservoirs, and ponds extensively distributed with the area.

A great variety of major game fish species occupy the available cold and warm water habitat. In addition, potentially valuable commercial fishery resources exist. Present use of these resources is limited because of market conditions, remoteness of markets, restrictive regulations, and the level of present technology. Nevertheless, the commercial fishery resource deserves careful consideration in development plans that would affect the operation of existing impoundments or lead to the development of additional reservoir sites.

Insects are not discussed in this collection of regional profile data. However, they are important food for many of the fish and wildlife species discussed and are a vital cog in every ecosystem inhabited by fish and wildlife.

Montana

Big Game

Big game in Montana include mule deer that inhabit the entire area; white-tailed deer, widely distributed in the eastern half of the study area but generally confined to river bottom lands and a few mountain areas in the western half; elk, confined in small widely dispersed, less accessible areas; antelope, dispersed over most open country except for the Coteau pothole country in the northeastern part of the State; bighorn sheep inhabiting a few rugged areas in small numbers; black bears found only in the mountains fringing the western border of the study area; and mountain goats, restricted to the Big Snowy Mountains at the western edge of the area. The mountain lion, classified as a game animal, is widely distributed, but exists only in small numbers in the more rugged areas.

Deer and antelope hunting in eastern Montana constitutes a recreational resource of national significance. Large numbers of animals provide a quality hunting experience to area residents and many people from other states.

Eastern Montana provides excellent habitat for the American bison and the plains grizzly bear. However, wild populations of these species have been eliminated.

The Crow, Fort Peck, and Northern Cheyenne Indian Reservations, comprising vast acreages within the study area, provide excellent habitat for various big game species. Unrestricted hunting by tribal members occurs year around, consequently populations of big game animals on these lands are very low.

Mule Deer. The mule deer is the most widely distributed and abundant big game animal. Usually, these deer occur more often in timbered and rugged areas. In southeastern Montana, spring, summer, and fall deer use is greater in lightly timbered areas in the ponderosa pine zone than in sagebrush and grasslands, (Knapp, 1973). Use of sagebrush and grasslands increases in winter. Brushy plants are the preferred deer foods, especially in winter, but forbs may comprise half of the mule deer diet in late spring and early summer. Mule deer population

densities in southeastern Montana are very high. Fawn production is also high. However, both population numbers and fawn production ratios have been declining slightly in the last few years. Mule deer populations are stable in northeastern Montana.

More than one-third of all deer harvested in Montana are taken within the NGPRP study area. In 1970, nonresident hunters harvested 42 percent of the 20,000-plus deer taken in Hunting District 7, which comprises roughly half of the NGPRP area.

White-Tailed Deer. The white-tailed deer is abundant along all the major river bottoms within eastern Montana. It also abounds in the Long Pines area of southeastern Montana, the Big and Little Sheep Mountain breaks north of Miles City, and the Big Snowy Mountains. Populations are high wherever this deer is found; fawn production is consistently good; and the distribution of this species is still increasing in some areas. The whitetail's preference for bottom lands results in concentrations on farms and other private lands, yet its food is still mainly browse plants. Statewide, whitetails comprise about 25 percent of the annual deer harvest. North of the Missouri River, white-tailed deer often exceed 40 percent of the deer taken.

Pronghorn Antelope. The pronghorn antelope population in Montana, estimated at 95,000 animals in 1968, is second in the world only to that of Wyoming (Sundstrom, Hepworth, and Diem, 1973). Antelope habitat consists primarily of grama-needlegrass-wheatgrass prairie, and some sagebrush steppe. Browse plants, mainly Wyoming big sagebrush and forbs, are the primary constituents of the antelope's diet. Antelope populations in lower quality habitat areas of northeastern Montana are decreasing; populations in the rest of the study area are increasing. In 1973, 32,000 antelope permits were issued statewide. In 1971, nonresidents harvested over 40 percent of the antelope taken in Hunting District 7.

Elk. Large areas of eastern Montana provide excellent habitat for Rocky Mountain elk. Currently, small elk herds inhabit the breaks of the Missouri River around Fort Peck Reservoir, the Bull Mountains,

and the Big and Little Snowy Mountains, all north of Billings, Montana, and the Pryor and Big Horn Mountains south of Billings. A small herd inhabits timbered breaks of the Yellowstone River southwest of Custer, Montana. Elk populations within the study area are stable. Limited hunting occurs only along the north side of Fort Peck Reservoir and in the Bull Mountains.

Bighorn Sheep. A small population of bighorn sheep inhabits the rough breaks area between the Yellowstone and Powder Rivers. Little is known of the present population except that sheep are commonly observed and the population is considered huntable to a very limited extent.

Mountain Goat. The Rocky Mountain goat is found only in the Big Snowy Mountains. This species inhabits high, rocky, alpine, and subalpine areas only. Its diet consists of grasses, shrubs, and forbs. The Big Snowy Mountain goat herd resulted from introductions totaling 20 animals in 1953 and 1954. The herd has increased slowly and has not been hunted.

Black Bear. Black bear inhabit the Big and Little Snowy, Pryor, and Big Horn Mountains. This species is usually restricted to large timbered areas, but occasionally individuals wander large distances from preferred habitat. Populations appear stable, hunting pressure is light, and hunter success is low in eastern Montana.

Moose. Moose occasionally frequent the Coteau pothole country of northeastern Montana, but do not regularly inhabit the area.

Mountain Lion. The mountain lion, a game animal rare in Montana, is found in timbered, mountainous areas. The lion is widely distributed throughout the least accessible parts of the study area, and hunting pressure is light.

Upland Game

A great variety of upland game animals are found in eastern Montana. Ruffed Grouse and Blue Grouse. Both ruffed and blue grouse occur in the Big and Little Snowy, the Pryor, and the Big Horn Mountains. Blue grouse are found in Douglas-fir timbered areas. These birds conduct a unique winter migration in reverse of elevation change patterns of most other animals. Blue grouse breed and rear their young in open forests of moderate elevation. In fall, they migrate uphill several thousand feet in elevation to winter in dense forests. Ruffed grouse inhabit mixed conifer-deciduous forests and frequent densely vegetated stream bottom lands. Blue and ruffed grouse hunting seasons and bag limits are liberal in Montana, but few are harvested within the study area because of these birds' limited range.

Sage Grouse. Over half of the sage grouse habitat in Montana occurs within the study area. This large bird depends on vast sagebrush areas. Forbs constitute a small part of the sage grouse diet during the summer, but the rest of the year the diet consists almost exclusively of Wyoming big sagebrush. In recent years, some sage grouse habitat has been eliminated or reduced in quality by sagebrush eradication programs. Areas critical to sage grouse are their spring strutting grounds and winter concentration areas. Sage grouse hunting is popular in Montana. The annual State harvest varies between less than 25,000 to almost 100,000 birds. Fall populations available for harvest depend mainly on weather during the nesting and brooding periods.

Sharp-Tailed Grouse. Sharp-tailed grouse, natives of the northern prairie brushlands, require standing grasses year-round for nesting, roosting, and cover, and shrub or tree thickets for food and cover. They use waste from grains, stock ponds, and shelterbelts. In many areas, farming and excessive livestock grazing have reduced sharptail habitat. Sharp-tailed grouse numbers fluctuate yearly, depending on severity of the preceding winter and weather during the breeding season. Statewide hunter harvest of sharptails in Montana varied from a low of 49,000 to a high of 140,000 birds annually in the period 1965 through 1969. More than half of this harvest occurs in the study area.

Ring-Necked Pheasant. This is the most successful exotic game bird introduced in Montana. The pheasant inhabits cultivated farm areas along major river and stream bottoms throughout eastern Montana and much of the upland farm areas of the northeastern corner of the State. Cereal grains constitute most of the pheasant's diet. Brush cover nearby and a good year-round food supply are essential to pheasant survival. Widespread changes in farming from grain to hay and pasture operations have caused a significant decline in pheasant populations from high levels of the early 1960's. More pheasants are harvested annually than any other game birds.

Hungarian Partridge. The Hungarian partridge is another exotic game bird successfully introduced to Montana. Except for dense timber or uninterrupted sagebrush, most of eastern Montana within the study area constitutes Hun habitat. Farmlands devoted to cereal grains interspersed with uncultivated areas and brushy draws provide excellent habitat for this small partridge. Populations fluctuate yearly, dependent upon spring and early summer weather.

Chukar Partridge. The exotic chukar partridge has been extensively introduced to arid areas of eastern Montana. Most introductions have failed. Severe winters have eliminated populations which reproduced successfully for a few years. Montana is probably a peripheral area of chukar range. Chukars are hunted annually, but only a few thousand are harvested in the State.

Turkey. Merriam's wild turkey was transplanted to central Montana in 1954 (Mussehl and Howell, 1971). The best turkey habitat is the open ponderosa pine forests in rugged areas of central and southeastern Montana. Ponderosa pine seeds are the preferred food. Seeds and leaves of a large variety of plants constitute most of the diet, but insects are eaten during the summer. From 1,500 to almost 3,000 hunters pursue turkeys annually in Montana. The harvest in recent years has varied from a few hundred birds to a high of 933 in 1963. Fall populations depend upon weather of the preceding winter and spring. In 1973, all of the turkey hunting in the State occurred in the study area.

Cottontail Rabbit. Three species of cottontail rabbits inhabit the study area of Montana. The mountain cottontail and the desert cottontail are widespread. The eastern cottontail is found only along the extreme eastern edge of the State. Usually, cottontails are common everywhere, but most numerous along river and stream bottoms, and least abundant at high elevations. The cottontail is not classified a game animal in Montana, and is lightly hunted.

Snowshoe Hare. The snowshoe hare is found only in the Snowy, Pryor, and Big Horn Mountains. This hare frequents the lodgepole pine and Douglas-fir zones. Population abundance is cyclic, and the species is only lightly hunted.

Mourning Dove. The mourning dove nests throughout most of eastern Montana. Nesting densities are highest in lightly timbered river and stream bottoms and breaks and north of the Missouri River. The Milk River valley is a prime nesting area. Thousands of doves are produced annually in Montana. They generally migrate south in mid-September. The mourning dove is not a legal game bird in Montana, and no hunting is permitted.

Waterfowl. While Montana produces thousands of ducks, mergansers, and geese, hundreds of thousands of ducks and many thousands of geese and sandhill cranes migrate through the study area in the spring and fall.

Ducks and Mergansers. The best duck production area in eastern Montana is the glaciated Coteau pothole country in the State's northeastern corner. Thousands of puddle and diving ducks are produced annually on the many ponds and lakes of this area. Ducks nesting in this area include the mallard, pintail, blue-winged teal, American widgeon, gadwall, shoveller, lesser scaup, and canvasback. Some puddle ducks, mainly mallards, are produced each year on numerous small stock ponds scattered over eastern Montana. The aggregate of this production is a significant waterfowl resource. Other ducks nesting in the study area or migrating through include the green-winged teal, scaup, redhead, goldeneye, ruddy, cinnamon teal, ring-necked, and bufflehead. Hundreds of common merganser nest along major streams in the study area, and the red-breasted merganser is a common migrant. Hooded mergansers are rare migrants.

Most native ducks migrate south in early fall before freezeup. Thousands of mallards and a few other puddle ducks winter in open water areas on the Missouri River below Fort Peck Dam, on the Big Horn River below Yellowtail Dam, and on the Yellowstone River downstream from Billings and Hysham. Ducks migrating south through the State and the overwintering mallards provide a significant hunting resource to Montanans. About one-fourth of the 190,000 ducks harvested in Montana in 1970 were taken in the study area.

Geese. Canada geese nest along the Yellowstone and Missouri Rivers and on stock ponds in Valley County. Islands are preferred nesting habitat along the major rivers. Thousands of Canada geese migrate through in spring and fall. Some of those nesting in the State migrate south to winter. Wintering Canada geese use open water of major rivers. The year-round open water of the Big Horn River below Yellowtail Dam and the Yellowstone River from the confluence of the Big Horn to the town of Forsyth are important Canada geese wintering areas. Several thousand snow geese and significant numbers of white-fronted and Ross' geese migrate through the study area in spring and fall. However, more geese migrate through further west and less than one-fifth of the State goose harvest occurs in the study area.

Cranes. During the months of October and November, 10,000 to 20,000 lesser sandhill cranes migrate south through the area. The lesser sandhill, also known as the little brown crane, nests in the Arctic and winters in the southwest. Limited hunting for these large birds occurs in Montana just west of the study area. A number of the very few whooping cranes left on earth migrate through the eastern portion of the study area in spring and fall, but rarely rest at Medicine Lake National Wildlife Refuge.

Swan. Probably less than 100 whistling swans migrate through the study area in spring and fall. Whistling swans are more common in western Montana, and limited hunting occurs there.

The American coot and the common snipe, also known as Wilson's snipe, both nest extensively on lakes and wetlands in the study area. Many thousands more migrate through the area in spring and fall, and are lightly hunted.

Non-Game Wildlife - Mammals

Furbearers. Furbearing mammals in Montana are legally classified as furbearers, predators, or non-game mammals. Aquatic furbearers include mink, muskrat, beaver, and river otters. Mink, muskrat, and beaver are widely distributed throughout the study area on rivers, streams, ponds and marshes. All three are classified furbearers, and comprise most of the annual furbearing animal harvest. In 1971, approximately 4,000 muskrat, 3,000 beaver, and 1,000 mink were trapped in the three game regions which the study area nearly encompasses. River otters inhabit most of the major river bottom lands, but in the study area are rare-to-uncommon. None were trapped in the area in 1971.

Coyotes and bobcats, classified predators in Montana, are widely distributed. The coyote is common everywhere, but is more numerous in rough country such as the river breaks around Fort Peck Reservoir, and

less numerous in extreme northeast Montana. Almost the entire State is classified excellent coyote habitat. However, in the 1972 predator survey of 17 western states, conducted by the U.S. Fish and Wildlife Service (BSFW, 1972), relative indices of coyote abundance were lower for each of the four states in the study area than for any other western state. Coyotes are trapped and shot, and have been extensively poisoned--mainly for control related to domestic livestock protection. Coyote pelts were worth little in fur markets until the spring of 1973, when the value of a prime hide rose to about $30, suggesting a likely increase in commercial coyote trapping. Bobcats are as widely dispersed as coyotes, but are much less abundant. They are more numerous in the southern portion of the study area, but are not common. In 1971, 360 bobcats were commercially trapped in the three game regions of the study area. In 1972, the bobcat pelt price skyrocketed to $90 for a prime hide on the Canadian fur market. Greatly increased trapping pressure is anticipated for this species.

The weasel, wolverine, and skunk are also classified predators. The long-tailed weasel is common in the study area, and a few are trapped each year. The least weasel is widely distributed throughout the area, but is rare. The short-tailed weasel inhabits the mountains fringing the western portion of the study area. The striped skunk is common throughout the area, but is more numerous in the eastern portion. Several hundred are trapped annually. Wolverines inhabit the mountains of Montana, but are rare. A few are trapped each year.

Red fox and Canada lynx are classified as non-game mammals. Foxes are now widely distributed throughout the area. Few were observed before the 1950's. Red foxes are more common along major river bottoms and numerous in northeast Montana. Over a thousand were trapped in the study area in 1971. Canada lynx inhabit forested areas where their main prey species, the snowshoe hare, is found. They rarely occur in the study area, but one was trapped in southeast Montana in 1971.

The badger and the raccoon are small predatory furbearers classified as non-game mammals in Montana. The badger inhabits prairie and sagebrush steppe, while the raccoon frequents river

and stream bottom lands. Both are trapped for their fur. A few opossum have been reported along the lower Yellowstone River in Montana. The nutria, a South American furbearing rodent, was introduced to the State by private fur breeders; but the species is not considered an area inhabitant.

The white-tailed jackrabbit is abundant in much of eastern Montana, and is hunted. The porcupine is common. The yellow-bellied marmot inhabits the mountains. Fox squirrels occur in the deciduous trees along the Missouri River upstream to Culbertson and on the lower Yellowstone River upstream to Sidney. The red squirrel and northern flying squirrel are common in the coniferous forests of the Snowy, Pryor, and the Big Horn Mountains. Ground squirrels common to the area include the Richardson ground squirrel and the thirteen-lined ground squirrel. The black-tailed prairie dog is common in eastern Montana. Prairie dogs are afforded complete protection on national wildlife refuges because they are part of the natural prairie ecosystem and because they are the prey species of the black-footed ferret, an endangered mammal which might survive in Montana.

The least chipmunk, Wyoming pocket mouse, and Ord Kangaroo rat are common in sagebrush areas of eastern Montana. The northern grasshopper mouse and western harvest mouse inhabit the grasslands of the study area. The northern pocket gopher, meadow jumping mouse, and white-footed mouse are widely distributed. The sagebrush mouse is a rare inhabitant. The hispid pocket mouse occurs in the southeast corner of the State. Small mammals inhabiting the mountains of the area are the bushy-tailed wood rat, pika, golden-mantled ground squirrel, and, possibly, the mountain phenacomys, water vole, and red-backed vole. Other small mammals of the area include the prairie vole, long-tailed vole, meadow vole, masked shrew, vagrant shrew, draft shrew, and northern water shrew in the high mountains, and rarely the Merriam shrew and Preble shrew. The house mouse and Norway rat are present. The western deer mouse is common in almost all ecotypes.

Bats common to the study area are the little brown bat, Say bat, big brown bat, hoary bat, and silver-haired bat. The spotted bat has been recorded and the long-legged bat may inhabit mountains in the area.

Non-Game Wildlife - Birds

Water Birds. The large rivers traversing the area, Lake Mason in Musselshell County, Fox Lake in Richland County, Medicine Lake in Sheridan County, Homestead Lake in Roosevelt and Sheridan Counties, the shoreline of Fort Peck Reservoir, and the stock ponds and small reservoirs constitute excellent summer nesting and spring and fall resting habitat for thousands of birds. A few of the most numerous nesting birds include a colony of 2,400 young and 3,700 adult white pelicans at Medicine Lake in the summer of 1973, large great blue heron rookeries scattered throughout the area, production of thousands of double-crested cormorants, California gulls, ring-billed gulls, Franklin's gulls, and eared grebes. Other important nesters include lesser yellowlegs, willet, American avocet, common tern, black-crowned night heron, upland plover, mountain plover, killdeer, and northern long-billed curlew. Other species migrate through the study area.

Birds of Prey. Montana supports an abundance of resident birds of prey, and serves as a wintering area for numerous eagles, hawks, falcons, and owls. The golden eagle nests throughout the area, and is common. Golden eagles, nesting farther north, winter here. In February 1973, golden eagle densities were projected at one golden eagle per 9 square miles in the center of the study area. Bald eagles have recently nested in the area, but no active nests were recorded in 1973. Significant nesting occurs to the west. Many bald eagles

winter in the area, frequenting Fort Peck Reservoir; Medicine Lake, and the Missouri, Yellowstone, and Big Horn Rivers. Wintering bald eagles also frequent upland areas. American osprey nested on Fort Peck Reservoir in 1970 and during summer are commonly observed along the reservoir and Yellowtail Reservoir on the Big Horn River. Commonly, observed are the marsh hawk, red-tailed hawk, Swainson's hawk, rough-legged hawk, sharp-shinned hawk, and the Kestrel. Less commonly observed, are the ferruginous hawk, Cooper's hawk, peregrine falcon, prairie falcon, and prairie pigeon hawk. Common resident and wintering owls include snowy owl, great horned owl, short-eared owl, and western burrowing owl. Less common are the barn owl, hawk-owl, western screech owl, barred owl, spotted owl, saw-whet owl, long-eared owl, and boreal owl. The turkey vulture is a summer resident and breeder in all but the extreme northeast portion of the area.

Passerines. See the Check list of song birds observed at Bowdoin National Wildlife Refuge adjacent to the study area in Montana.

Reptiles. Reptiles of the area include the prairie rattlesnake, common garter snake, plains garter snake, western garter snake, bull snake, racer, hog-nosed snake, and milk snake. Other reptiles include the snapping turtle, painted turtle, and softshell turtle.

Amphibians. The plains spadefoot toad is widespread. The Great Basin spadefoot probably inhabits portions of Big Horn and Yellowstone Counties. The Dakota toad occurs mainly north of the Missouri River, while the Rocky Mountain toad is widespread south of the river. The Great Plains toad inhabits most of the area; the boreal chorus frog, the leopard frog, and the tiger salamander inhabit the entire area.

Endangered Species of Montana. The threatened wildlife species are defined as those species or subspecies that are so few in numbers or so threatened by present circumstances as to be in danger of extinction.

Black-footed ferrets were formerly widely distributed over eastern Montana, but were never numerous. This carnivore preys mainly on the black-tailed prairie dog. Although no ferrets have been reported in Montana in several years, evidence indicates their presence on the Charles M. Russell National Wildlife Refuge of Fort Peck Reservoir.

Little is known of the spotted bat. Only a few species have been observed--one in Yellowstone County.

The whooping crane is a very rare spring and fall migrant in extreme northeastern Montana.

The prairie falcon was observed several times at Medicine Lake National Wildlife Refuge in 1972.

Nine observations of American peregrine falcons were made at Medicine Lake in 1972.

The tule white-fronted goose breads in northern Yukon Territory and winters in Texas and Louisiana, occasionally overflying eastern Montana in spring and fall.

Status-Undetermined Species. A status-undetermined species is one that has been suggested as possibly threatened with extinction, but about which there is not enough information to determine its status. The following inhabitants of the study area are classified by the Department of the Interior as "status-undetermined."

The ferruginous hawk is reported common at UL Bend National Wildlife Refuge, which borders the study area at Fort Peck Reservoir.

The American osprey nested at Fort Peck Reservoir in 1970, and was observed there in 1971. It is also regularly observed at Yellowtail Reservoir on the Big Horn River.

The prairie pigeon hawk was observed at UL Bend National Wildlife Refuge in 1971.

The mountain plover is commonly observed in the vicinity of prairie dog towns on Charles M. Russell National Wildlife Refuge, Fort Peck Reservoir.

The northern long-billed curlew commonly nests near small stock ponds throughout the study area.

The western burrowing owl is also commonly observed at prairie dog towns on UL Bend and Charles M. Russell Refuges. About 100 were observed at one time in the fall of 1971 at UL Bend.

The range of the northern swift fox includes most of the study area. None have been reported recently in the area, but one was observed on two occasions in 1969 and once in 1970 at Bowdoin

National Wildlife Refuge, a few miles west of the northwest corner of the area.

The pine marten, wolverine, and Canada lynx are rare but regular inhabitants of mountains fringing the western portion of the study area. Here, they appear to be inhabiting the periphery of their habitat.

Montana

Fish

The Montana study area encompasses a variety of fish habitats including large rivers flowing generally east, mountain streams, and intermittent small tributaries on the plains. A large number of stock watering ponds and reservoirs, scattered throughout the area, contain several fish species. The bulk of fish habitat in the area is found in a few large reservoirs (Tongue River, Fort Peck, and Yellowtail) and in such major Missouri River tributaries as the Tongue, Powder, Big Horn, and Little Bighorn Rivers. Much of the area occupied by these stream-reservoir systems is classed as warm water habitat, although smaller tributaries and the headwater areas of a few streams in the mountains provide cold water environment. Intermediate areas provide habitat for a mixure of cold and warm water species.

The existing distribution of fish and species composition has been conditioned to some degree by manmade barriers and modification of water quality involving irrigation return flows, domestic effluents, and sedimentation. There are no "blue ribbon" trout waters within the confines of the program areas, but several streams in the study area are prime trout waters and possess other unique attributes. The Yellowstone River is free flowing, scenic, and among the few streams with a high quality, natural, self-sustaining fishery. Manipulation of the natural qualities of this river would seriously impact important fish and wildlife resources and associated natural values.

All species are important biological components of the ecosystems discussed, either functioning trophically as carnivores, forage fish, or scavengers. Several species occurring in the area are of special note. The paddlefish, pallid sturgeon, and shovelnose sturgeon are three unique species because of their evolutionary history and limited distribution. The life cycle of these fish is not well known, particularly regarding spawning requirements. The paddlefish is highly prized because of its large size, sporting characteristics, and edibility. It is relatively common in the Missouri and Yellowstone

Rivers, and is thought to spawn in some of the Yellowstone tributaries. The pallid sturgeon is important primarily because of its large size, rarity, and value as a trophy fish. The shovelnose sturgeon is not a highly sought species, and generally is taken incidentally by fishermen when snagging for paddlefish and pallid sturgeon.

There are no threatened species based on national criteria (BSFW, 1973), but, on a State basis, several species are considered rare or endangered and worthy of preservation. The rare or endangered status has usually been applied to those species whose former habitat has deteriorated and resulted in a reduction in the range of the species to a few restricted areas. On this basis, the shovelnose sturgeon in the Missouri and lower Yellowstone Rivers is considered threatened.

Fish Distribution and Species Composition. There is a paucity of information for many of the smaller tributaries. The streams and reservoirs are characterized as cold water, warm water, and transitional waters (from cold to warm water). The delineation of these areas generally applies to the type of species typically found in a given area. Although spatial and temporal distributions could deviate significantly over the period of a year, this delineation is based on the summer period when flows are lowest and waters demonstrate the highest temperatures.

The Fish Habitat Map, (Appendix I, Figure 19), depicts the approximate zones occupied predominantly by cold water species, an intermixture of cold and warm water species and those dominated by warm water species. Species composition within the three zones are described below. Distribution of species considered as exceptionally important game fish are individually expressed on the basis of available data.

Cold Water Habitat. Usually, the cold water habitat is limited to mountainous and closely associated terrain. In the Montana study area, cold water fisheries are found only in the small streams of the Pryor, Big Horn, and Snowy Mountains. These are dominated by salmonid species, including the rainbow, brown, and brook trouts occurring

either as single species or as multi-species populations. Because of the limited number of easily accessible salmonid waters, these streams receive considerable fishing pressure, and often require stocking to sustain populations. Natural reproducing populations are limited, although the brook trout reproduces naturally in some streams.

Outstanding trout fisheries all lie outside the study area, but areas about some of these waters are being considered for coal development. These include the Yellowstone and Boulder Rivers in Montana. In these areas, the valued fisheries consist of large populations of rainbow trout, brown trout, and brook trout. The Yellowstone and many of its tributaries support good populations of cutthroat trout.

Mixed Cold and Warm Water Species. The deeper reservoirs and associated tailwater areas downstream are generally the habitats supporting mixed populations. The dominant types of fish in a mixed population vary with each reservoir and location within the reservoir. Downstream from the reservoir, trout species usually dominate the upper area of the stream, becoming subdominant downstream as it grades into a warm water environment. The cold water species in these mixed fisheries usually result from continuous stocking and other concerted management programs subsequent to reservoir impoundment. Species introduced widely include the rainbow trout and the brown trout. Lake trout, another introduced species, is restricted in distribution to Yellowtail and Fort Peck Reservoirs because of habitat requirements. Coinhabiting the reservoirs are a number of warm water species representing both game fish and non-game fish. Widely distributed game fish in the reservoirs include walleye, sauger, northern pike, black crappie, and white crappie. Other game species with a more restricted distribution include paddlefish and channel catfish in Fort Peck Reservoir and largemouth and smallmouth bass in Tongue River Reservoir. Several non-game warm water fish are found in reservoirs, and include the black bullhead, flathead chub, shorthead redhorse, stonecat, white sucker, and yellow perch. Species with a more restricted distribution include the bigmouth buffalo, blue sucker, brook stickleback, burbot, carp, emerald shiner, fathead minnow, flathead chub, goldeye, lake chub,

northern redbelly dace, pallid sturgeon, plains minnow, river carpsucker, and smallmouth buffalo in Fort Peck Reservoir and the golden shiner, longnose dace, and yellow bullhead in Tongue River Reservoir. All of the game species listed previously, with the exception of the lake trout and largemouth bass, are often also inhabitants of the mixed fisheries below existing reservoirs. Many of the non-game species listed above are not found in great abundance in these areas, with the exception of carp, flathead chub, goldeye, golden shiner (Tongue River), northern redbelly dace (Missouri River), stonecat, white sucker, and yellow perch. Non-game fish found principally in the tailwater areas below the reservoirs are longnose sucker, goldfish (Tongue River), rock bass (Tongue River), shortnose gar (Missouri River), and shovelnose sturgeon.

Warm Water Species. The widely distributed game fish in the warm water environments are the channel catfish, sauger, and walleye. Paddlefish, white crappie, and smallmouth bass have more restricted distributions. Warm water areas are dominated largely by non-game fish, some of which are also components of mixed populations, both in the reservoir and the downstream areas. These species are usually widespread in distribution and tolerate a wide range of environmental conditions; include the black bullhead, burbot, carp, emerald shiner, fathead minnow, flathead chub, goldeye, lake chub, longnose dace, plains minnow, river carpsucker, shorthead redhorse, silvery minnow, smallmouth buffalo, stonecat, and white sucker. Other warm water species with a more restricted distribution include the creek chub which is limited to the lower Yellowstone and Little Missouri Rivers and is considered quite rare, blue sucker (Yellowstone and Milk Rivers), brassy minnow (lower Missouri and Yellowstone River drainages), finescale dace (Milk River), freshwater drum (lower Missouri and Yellowstone Rivers), golden shiner (sparsely found in the Missouri and Yellowstone River drainages), mountain sucker (lower Yellowstone River), pallid sturgeon (lower Yellowstone and Tongue Rivers), plains killifish (Big Horn River), rock bass (Tongue River), shovelnose sturgeon (lower Yellowstone and Missouri Rivers), pearl dace (lower

Yellowstone), sturgeon chub (Yellowstone and Tongue Rivers), sand shiner (lower Yellowstone), and green sunfish and bluegill (lower Yellowstone).

The Tongue River and Tongue River Reservoir are the only bodies of water in eastern Montana with a smallmouth bass population. The Tongue River is the only stream in Montana containing rock bass.

Sport Fishing. A large segment of the fishing pressure occurs on larger reservoirs and associated tailwaters. The attraction of fair-to-good mixed fisheries, good public access, and the opportunity to combine fishing with such other types of outdoor recreation as boating and picnicking, along with a shortage of trout streams, account for this use.

Present fisherman use of Fort Peck Reservoir may approach 40,000 angler days annually, despite its remoteness from population centers and the difficulties inherent in fishing such a large water body. Big Horn Lake use may exceed 20,000 fisherman days annually.

Within the study area, Yellowstone and Big Horn Rivers support at least 30,000 and 12,000 angler days, respectively. The Yellowstone fishery is almost exclusively for warm water species, especially paddlefish; most of the Bighorn use is attributable to an artificially created and maintained high quality rainbow trout fishery downstream of Big Horn Reservoir.

Excluding Big Horn River for several miles below Yellowtail Dam, the purely trout waters within the study area are limited to a number of mountain lakes and small streams. Good use is made of these waters where access is reasonably available, but this use does not constitute a large segment of total fishing pressure in the area.

North Dakota

Big Game

North Dakota, like the other states, has a variety of big game animals.

White-Tailed Deer. White-tailed deer are native to North Dakota, and are distributed in all areas where suitable habitat occurs. Such habitat is found in the western one-half of the State and many areas support a thriving population. Habitat varies by ranges from weedy fence rows in farming areas; marsh vegetation interspersed with farmland or prairie grasses; woody cover occurring in native grasslands and badlands terrain; and typical native woodlands which occur as upland ranges or as wooded meanders of the larger streams and rivers.

White-tailed deer require the tender shoots of various trees and shrubs as food, however, this is often supplemented by agricultural crops. Corn, alfalfa, and various fruits are particularly relished.

The winter population of whitetails has remained fairly stable over the last 20 years, and the Statewide density probably averages more than one deer per section of land. There are probably 80,000 white-tailed deer in North Dakota. An average of about 27,500 hunters harvest more than 19,000 deer in the western one-half of North Dakota each year. About 77 percent of this harvest is white-tailed deer.

Mule Deer. Mule deer, native to North Dakota, are more dense in the prairie-butte and the badlands terrain of the western one-half of the State. Habitat requirements are native vegetation of the more rolling topography. Brushy hillsides, hardwood draws, and badlands ecosystems support yearlong mule deer populations. Intensive agricultural operations and overgrazing by domestic animals have reduced the carrying capacity of the land for mule deer. A population estimate of about 20,000 animals is considered reasonable. About 23 percent of the annual deer harvest is mule deer.

American Pronghorn (Antelope). American pronghorn were decimated to but a few bands in the extreme western portion of the State by the mid-1920's. Protection, management, and replants have reestablished

this animal to much of its former range in the western one-half of North Dakota. Native prairie vegetation and open grassland terrain is preferred by this species during most of the year. Requirements during critical winter periods include good woody browse located on or near more rolling, rougher terrain. Pronghorn densities vary with some of the higher densities approaching 1.5 animals per square mile. Estimated populations range from 6,000 to 14,000 animals. During an average hunting season, about 2,100 hunters harvest nearly 1,900 pronghorns.

Bighorn Sheep. California bighorn sheep were introduced into North Dakota in 1956 to replace the Audubon sheep after its extinction. Possibly, 350 (1973 estimate) bighorns occupy portions of badlands terrain contributing to the Little Missouri River drainage. Their feeding preference is about equally divided between woody plant materials and prairie grassland vegetation. Remote areas are preferred by this species. The last recorded harvest of bighorns occurred in 1905 on the Magpie Creek drainage in the McKenzie-Billings County area.

Upland Game

Numerous upland game abound in North Dakota.

Ruffed Grouse. Ruffed grouse are found only in the wooded areas of Pembina Hills and Turtle Mountains. A very small population may exist in the Killdeer Mountains in Dunn County.

Ruffed grouse require extensive stands of aspen in different age classes to maintain high densities. Such understory shrubs as beaked hazel, highbush cranberry, chokecherry, rose, hawthorne, plum, and others provide needed food. Male aspen buds are favorite, and one of the most important, winter foods of grouse.

Ruffed grouse populations are cyclic, with highs and lows occurring about every 10 years. However, the severity of population changes can be reduced some with good grouse management, which, in essence, means good aspen management.

A decline in populations can be attributed to a loss of woodland: in the Turtle Mountains, at the rate of about 2 percent a year, and in the Pembina Hills, at about 3 percent. If this trend continues, ruffed grouse populations will continue to drop. Ruffed Grouse receive considerable hunting pressure from local hunters, and appear to be providing recreation for more people who reside away from the area.

Currently, the North Dakota Game and Fish Department is engaged in a trapping and transplant project to establish grouse in the Killdeer Mountains of Dunn County and in the Sandhills of McHenry County.

Prairie Chicken. Currently, only isolated flocks occur along the eastern edge of the Coteau or western edge of the Red River Valley, in extreme eastern North Dakota.

Sage Grouse. The sage grouse was never widespread over North Dakota, and is presently confined to the western portions of Slope and Bowman Counties and southern part of Golden Valley County. This species is

very dependent on big sage, and inhabits only those areas where this shrub is common to abundant. This sage species is important for nesting, brood rearing, and roosting. It is also a critical food source during fall and winter. Insects, waste grain, and green leaf material are important summer food items for adults and young.

Because of its limited numbers, the sage grouse has never been an important game species in North Dakota. Since 1963, limited seasons have been held each year, with 100 to 200 hunters participating annually and harvesting about one bird per hunter.

Sharp-Tailed Grouse. The sharp-tailed grouse inhabits grassland areas, reaching greatest abundance where good quality grassland is interspersed with native brush and shrub species. Native grass and brushlands provide all that is needed for the sharptail to exist in good numbers, but it will utilize croplands for food at certain times of the year. Intensive farming or overgrazing can eliminate or limit sharptail numbers.

The sharptail is North Dakota's most important native upland game species, with the harvest averaging about 125,000 grouse each year during the 1966-1972 period. In 1972, over 62 percent of the harvest occurred in southwestern North Dakota, but generally averages only 50 percent of the total Statewide harvest. Hunters average 1.5 birds per hunter per trip.

Pheasants. The ring-necked pheasant was introduced into North Dakota in 1910. They are very adaptable and usually thrive where there is good dispersion and good association of their food, winter cover, and nesting requirements. Preferred foods of the ring-neck are such crops as corn and small grain occurring as waste, and also weed seeds. Winter-cover areas are shelterbelts, willow, or plum thickets, or such tall herbaceous vegetation as aquatic vegetation, sweetclover, or annual weeds. These winter-cover areas must be of sufficient size or arranged in such a way that part remains free of drifting snow. Nesting cover may be almost any herbaceous growth of medium height and density which will remain undisturbed during May and June. Free water is usually not necessary except during drought periods when dew is lacking.

The pheasant is extremely vulnerable to severe winter weather. Intensive lan use, which has eliminated much of the good winter survival cover and undisturbed nesting cover, has reduced the pheasant numbers to a low level.

The ring-necked pheasant is found in all counties of the study area. The Statewide harvest in North Dakota has averaged nearly 50,000 birds during the years when open seasons were held. During 1972, 71.8 percent of the State harvest occurred in the study area, compared to 61.3 percent in 1971 and 68.9 percent in 1970.

Hungarian (Gray) Partridge. The Hungarian partridge is an exotic bird that made its first appearance in northwestern North Dakota in 1923. Through 1936, approximately 8,000 birds had been released

in North Dakota. In 1934, the first hunting season was held, with a big limit of three and possession limit of six.

This bird is associated with agriculture and with open rangeland of southwestern North Dakota. It nests in odd-idle areas such as fence lines, field borders, ditches, and other areas associated with farmsteads. It uses the waste grain in fall and winter stubble as a major food item. Huns do no damage to crops, and benefit the farmer by making insects a major part of their summer diet.

They are prolific breeders and have the greatest biotic potential of any of our upland game birds, but this full potential is never realized because of limiting factors. Population trend data show declines.

A possible explanation for the drop in numbers over the years might be found in changing agriculture, typified by more intensive land use, large farm size, more efficient and cleaner farming practices, and widespread use of various agricultural chemicals.

In 1972, 107,694 Hungarian partridge were harvested. Approximately, 30 percent of this harvest occurred in western North Dakota.

Wild Turkeys. Wild turkeys in North Dakota are associated with a variety of habitats. The Eastern variety is mainly a bird of the forest and river bottoms, while the Rio Grande and Merriam subspecies are found in the rough, broken country of the southwestern portion of the State. Diets usually consist of grass, leaves, matured seeds, waste grains, and grasshoppers. However, harsh winters, coupled with the general lack of natural food sources, drives wild turkeys to nearby farm or ranch sites where they feed off haystacks (primarily oats) which are used for cattle feed. Thus, they tend to become a nuisance, as well as semidomesticated.

West of the Missouri River, wild turkeys are found along the Heart River drainage in Morton and Grant Counties, Killdeer Mountains in Dunn County, Pine Forest area of Slope County, and along the Little Missouri River in McKenzie, Billings, and Bowman Counties. A recently completed range inventory revealed most suitable habitat is now occupied west of the Missouri River. The Statewide overwinter

population has averaged 1,123 for the past 16 years. Through 12 hunting seasons, an average of 141 wild turkeys have been harvested annually.

Waterfowl.

Duck and goose migration and nesting occurs throughout the area, with extremely high use north and east of the Garrison Reservoir and Missouri River. This eastern area is characterized by the Drift Plain and Coteau, which form the prairie pothole region supporting high numbers of breeding and migratory ducks. Destruction of wetland habitat continues to plague these species.

The southwest portion of the State, although limited in waterfowl habitat, contains areas of strategic importance. Isolated concentrations of waterfowl occur throughout the area during spring and fall migration. Digouts and stockponds throughout the southwestern slope region usually have several species of breeding pairs.

Large numbers of geese, as well as ducks, depend upon good water conditions in the Drift Plain and Coteau, to arrive at their breeding grounds in good condition. The value of North Dakota wetlands to these migratory species cannot be underestimated. Nesting of Canada geese occurs on refuges in portions of North Dakota. Introduction of Canada geese to establish free-flying birds is just beginning in the southwest portion of the State.

Mourning Dove. The mourning dove is widespread over North Dakota. Key areas are the wooded river valleys, draws, and shelterbelts which provide essential nesting and roosting sites. The bird is highly dependent on wheat and corn, and wheat harvest probably plays an important part in the formation of flocks and in the local movement of such concentrations. The mourning dove feeds almost exclusively on the seeds of herbaceous plants. Nothing in its habits constitute problems to agricultural interests, and the bird is favored by most citizens. The bird is not legal game in the State, and every recent effort to place it on the game list has failed by a wide margin.

Non-Game Mammals

Jackrabbits. Jackrabbits are residents of open plains. Cover more than 2 feet high is usually avoided except during severe weather. Home ranges vary in size, but are normally 1 to 2 miles in size. They consume a wide variety of food. Populations depend largely on the extent of winter mortality and the success of the breeding season. Western North Dakota is considered excellent jackrabbit range, with very high densities in some areas. Harvest averages 15,000 animals annually in this area.

Snowshoe Hare. Within the study area, these hares are limited to the wooded Pembina Hills and Turtle Mountains. Lesser numbers are found along the Missouri River bottoms.

A trapping and transplant project in the 1960's, introduced snowshoes to the Killdeer Mountains of Dunn County and along a portion of the White Earth River in Mountrail County. A few have been seen since 1972 in the White Earth Valley. No reports of snowshoes in the Killdeers have been made recently. This species is presently unprotected in North Dakota, but hunting interest is light.

Cottontail Rabbit. Cottontails require a year-round supply of excellent food and cover. Good cover is needed to withstand periodically severe winter storms. Food requirements must be a high energy, high protein type, such as waste grain, for maximum populations. Three species of cottontails occur in western North Dakota. These are the eastern, mountain, and desert cottontail. Presently, populations appear to be increasing.

Yearly populations depend largely on the extent of winter mortality, the success of the breeding season, and the amount of dense cover along stream courses. Cottontail harvests average 15,000-20,000 annually in western North Dakota. The animal is currently unprotected in North Dakota, and hunting interest is light to moderate.

Beaver. The prime beaver streams in western North Dakota are the White Earth Creek (Mountrail County) and Deep Creek (Slope County). Prime beaver streams are considered as those having densities of one colony per 1.5 miles stream. Other large streams in the State are

all considered moderate to poor in respect to beaver habitat. It is likely that beaver ponds on smaller streams and coulees are beneficial as livestock watering sites in much of western North Dakota. Approximately 500 beaver are harvested in western North Dakota annually.

Mink and Muskrat. Currently, little is known about the effects of water quality on these two species. However, it is obvious that the presence of water is essential for muskrats, and at least partially essential for mink. Streams are of utmost importance to western North Dakota mink-muskrat populations. Major alterations in streams are likely to depress populations in this area. Annual harvests of mink and muskrats in western North Dakota are estimated at 2,000 and 20,000 animals, respectively.

Weasel. Weasels prefer thickets, brushy fence rows, and rock piles. They consume other small animals, most of which are fresh killed. A small amount of carrion is consumed. Weasels are generally distributed throughout all of western North Dakota. They provide a significant amount of trapping recreation and income for young people when fur prices are good. The weasel harvest averages about 600 animals annually. Limiting factors for weasels in the northern prairies probably include mortality from such larger predators as the great horned owl, accidental death, and disease.

Raccoon. The raccoon is found in nearly all parts of the State. Today, however, their numbers are still higher east of the Missouri River. They were reported on the Little Missouri River in 1955, from whence they have spread nearly everywhere.

Raccoons feed on nearly any food, including fruits and poultry; but aquatic animals comprise their main diet. In many areas, they are serious predators. Raccoons are usually found in habitat associated with water, river drainages, and sloughs. The raccoon pelt has never been considered valuable, but pelts did sell for $6 to $8 in 1950 with the demand for "Davy Crockett" caps. They are currently selling for about that amount.

Skunk. The striped skunk is found in most of North Dakota, but is more common in areas east of the Missouri River. The skunk population fluctuates greatly; apparently, rabies disease is the main controlling factor as the skunk acts as the chief reservoir of the disease.

Diversified farming is apparently beneficial to the skunk by providing a varied food source. Small grains, fruits and berries, poultry and game birds, small mammals and aquatic life, make up the main diet. Most land use changes do not affect the skunk. Large farms, practicing clean, efficient farming methods, would probably be detrimental. Striped skunk pelts have never been valuable.

Porcupine. The porcupine is common to western North Dakota, but is also found occasionally in the eastern part of the State. Today, the porcupine is usually killed upon sight because domestic livestock and dogs may be harmed by the quills. They have little or no economic value, but are an interesting part of the fauna of the study area. The porcupine has few natural enemies, although coyotes and bobcats have killed them.

Black-Footed Ferret. Although unconfirmed sightings of the black-footed ferret have been reported, no major field efforts have been made to determine its existence. Ferrets have never been abundant throughout their range, and it is difficult to determine whether their population is declining. Dispersal of the family unit during early fall further complicates documenting their numbers or locale. The numerous unverified sightings leave little doubt that the ferret is capable of living within the State.

Prairie Dogs and Towns. The black-tailed prairie dog is mostly confined to the southwest portion of North Dakota, with the highest number of "towns" located on Theodore Roosevelt National Park and in Sioux County. Control measures and land use changes have reduced them to the present levels. Prairie dogs are colonial. They do not live where the ground is soft and, more especially, where the grass grows so tall that they cannot see over it. It is believed that on the prairie where the grass is naturally short, the prairie dog is a desirable animal because they contribute to enrichment of the soil. On the negative side, an area occupied by a colony is stocked to its capacity and is of little or no value for grazing or agricultural purposes. Found in close association with prairie dogs is the rare black-footed ferret.

Lynx. The lynx is uncommon in North Dakota. Its present range is confined to the Turtle Mountains. The lynx seldom preys on domestic stock, but will take poultry and is quite dependent upon rabbits and small game birds for food. The lynx is rarely found away from timbered areas. Lynx pelts have ranged widely in value. In 1973, when the demand for long-haired furs increased, some pelts sold for $150 each.

Coyote. The coyote has always been more numerous west of the Missouri River. Coyotes began to increase in 1960, and are presently considered to be at their highest since the 1930's. The coyote is very adaptable, and can prosper among humans provided they are not crowded. Coyotes are generally found along river drainages and in heavy brush because of a better food supply and escape cover. They are common in the Badlands, Killdeer, and Turtle Mountains, and the Pembina Hills.

Farming practices that reduced tall, dense vegetation has made the coyote more vulnerable to hunting and caused the loss of denning locations. Coyotes' predation on domestic stock has been of concern to the livestock industry. Bounties, paid in North Dakota for many years, were finally discontinued in 1961. The paid professional hunter system has proved useful in removing the offending animals. The value of coyote pelts has been low for many years; but, when long-haired furs became popular, pelts sold for as much as $25 in 1973.

Red Fox. Early records show the red fox was found over most of North Dakota. By 1957, they were common over the State except in the main river drainages west of the Missouri, where fairly high coyote populations remain.

Populations seem to fluctuate according to food availability, cover, and harvest pressure. Some areas of the State presently have two to three foxes per section. The red fox readily feeds on nearly any protein, including insects, small mammals and birds, carrion, aquatic life, and even berries. The fox is adaptable to most habitat types, but prefers rolling farmland with brush patches and sloughs. In 1973, some pelts sold for $30, and trapping has again become popular because of the price. An estimated 40,000 foxes were harvested during the 1972-73 winter. The fox population remains quite constant, even with this large harvest.

Badgers. The badger frequents most of North Dakota, but is less common in timbered and intensive farming areas. The badger often preys on poultry, but principally seeks ground squirrels, prairie dogs, and pocket gophers for food. Badgers prefer sandy type soils where they can easily dig for food. Aside from the large hazardous holes they dig and the poultry they eat, they are quite beneficial.

Diversified farming practices appear to favor the badger with small grain, poultry, and livestock furnishing a constant food supply. Recent interest in long-haired furs has generated some trapping activity.

Bobcat. The bobcat range is generally west of the Missouri along the river drainage, but some have recently been taken in eastern North Dakota. The bobcat diet includes small game birds, animals, and domestic poultry--but they are quite dependent on cottontails.

Little land use change affects the bobcat, except overgrazing which removes some brush and, in turn, reduces the amount of prey available. Pelt prices have always been of low value, until 1973 when some were sold in excess of $100.

Fox Squirrels. Fox squirrels are residents of heavily wooded river bottoms. They will inhabit open prairies to some extent, provided there are large trees and a high energy food supply nearby. Yearly populations depend on the extent of winter mortality and the success of the breeding season. Squirrel distribution is limited in western North Dakota. Highest densities are observed in association with major stream courses and other areas containing dense stands of timber, such as shelterbelts.

Bats. Bats recorded in the North Dakota study area include the little brown myotis, also commonly called the little brown bat, the small-footed myotis, the silver-haired bat, the hoary or gray bat, the red bat, and the big brown bat. They are generally beneficial because of their destruction of numerous night-flying insects that are injurious to both plant and animal life. Unfortunately, they are also carriers of rabies virus; but, then, so are many other mammals, and infection from bats is rare. During winter, some of the bats hibernate and others migrate to warmer climates. The big hoary or gray bats migrate to the southern states, while the big brown bats are examples of hibernators.

Small Mammals. Small mammals include native and introduced mice, voles, shrews, native and introduced rats, ground squirrels, chipmunks and gophers. Collectively, this group inhabits the entire area from the lowest to the highest elevations and from the driest to the wettest sites. They can survive against a wide range of environmental restraints which are often effective barriers to larger and more specialized animals. Although small in size their immense numbers make them extremely important in the high plains biosystem. They constitute a basic stage in the food chain and are a most interesting, if often secretive, group of animals.

Mice recorded in the North Dakota study area include the jumping, pocket, house, white-footed, harvest, and grasshopper mouse. Voles include the meadow, prairie, and red-backed vole. Bailey (1926) also reports the presence of the uncommon pale mouse (vole). Shrews found in the area include the masked, Merriam, Richardson, and short-tailed shrew. The pygmy shrew may also be resident. There are two species of rats in the North Dakota area, one is the native kangaroo

rat or pack rat and the other is the introduced Norway or brown rat. Ground squirrels are represented by the thirteen-lined, Richardson and Franklin. Chipmunks include the Little Northern, gray and the least chipmunk. The first two are found in the Turtle Mountains portion of the North Dakota study area. The sagebrush Badlands country along the Little Missouri River has high populations of the least chipmunk. The plains pocket gopher inhabits the entire North Dakota study area.

Non-Game Birds

Sandhill Crane. The sandhill crane formerly bred in Bottineau, Renville, Mountrail, Burke, McKenzie, Mercer, McLean, Stark and Adams Counties. This species was associated with large natural basin wetlands or reverine marches. No breeding records are known from about 1920-1972. However, a pair with dependent young was observed on J. Clark Salyer National Wildlife Refuge in 1973. Thousands of migrating lesser sandhill cranes overfly western North Dakota in the spring and fall.

Shorebirds. The numerous lakes and small wetlands of North Dakota form favorable habitat for some 22 migrant shorebirds and provide breeding sites for 10 other species of shorebirds. The breeding species include the American avocet, piping plover, killdeer, long-billed curlew, marbled godwit, upland plover, spotted sandpiper, willet, Wilson's phalarope, and the common snipe. Usually, these species reach their greatest abundance in the prairie pothole region, particularly the Coteau, and are scarce elsewhere. Exceptions are the killdeer and the upland plover which are found quite commonly throughout the Great Plains region of North Dakota. Also the long-billed curlew now breeds only in the southwest corner of the State, primarily in Slope and Bowman Counties. Formerly, it was a common breeder throughout most of the State.

There is no common ingredient of habitat for all these species but prairie grasslands and wetlands form the key environmental components for most shorebird requirements. The American avocet and the piping plover generally prefer the more saline lakes and wetlands and nest on the beaches. Killdeer and spotted sandpipers have wider latitudes in habitat preferences and also nest along the shoreline. The other shorebirds generally utilize fresher wetlands and all nest in grasslands--particularly unplowed prairie.

Birds of Prey. The bald eagle is extinct as a breeding bird in North Dakota. Migrant bald eagles pass through North Dakota in the spring and fall, and are commonly associated with wetlands containing fish or concentrations of waterfowl.

The golden eagle breeds in North Dakota west of the Missouri River, primarily along the Little Missouri River in Billings and McKenzie Counties. Large nests, composed of sticks, are usually built on the sides of buttes or steep escarpments. Occasionally, nests are built in large cottonwood trees. This species has been extirpated as a breeding bird along most of the Missouri River in North Dakota because of construction of large reservoirs. Large numbers of golden eagles which nest in Canada, winter in western North Dakota.

There are 10 species of hawks, 6 species of owls, and 1 species of vulture which nest in the western plains of North Dakota. The nesting hawks include the Coopers hawk, sharp-shinned hawk, marsh hawk, Ferruginous hawk, red-tailed hawk, Swainson's hawk, broad-winged hawk, American Kestrel, pigeon hawk, and prairie falcon. The breeding owls are the screech owl, great horned owl, long-eared owl, short-eared owl, burrowing owl, and barred owl. The only breeding vulture is the turkey vulture.

Each hawk species has different habitat preferences with the Ferruginous and Swainson's hawks preferring open terrain and nesting in low trees or on the ground. Red-tailed hawks utilize trees in the open or woodlands for nesting but generally hunt in open country. Marsh hawks nest in marshes or in tall grass on the ground and hunt grasslands, cropland, and marshes. The broad-winged hawk, Coopers' hawk and sharp-shinned hawk all nest and hunt mainly in woodlands such as the Turtle Mountains. American Kestrels nest in trees usually in open terrain and the prairie falcons usually nest on cliffs in canyon or badland habitats.

Most owls nest and utilize woodlands extensively for their life requirements, but short-eared owls nest on the ground and hunt grasslands; burrowing owls nest in holes in the ground and hunt open terrain.

Passerines. The passerines (Order Passeriformes) include all the perching birds. In the Great Plains area, 88 species of passerines breed and another 25 to 35 species utilize the habitats during migration. This group has adapted to utilize all habitat types within the region including woodlands, wetlands, and grasslands.

The ecological associations of breeding passerines and habitat are as follows:

Cropland--horned lark, bobolink, Western meadowlark, brown-headed cowbird, lark bunting, Savannah sparrow, McCown's longspur, chestnut-collared longspur.

Domestic Hayland--bobolink, Western meadowlark, dickcissel, grasshopper sparrow, common yellowthroat, brown-headed cowbird, lark bunting, Savannah sparrow, vesper sparrow.

Retired Cropland--Western meadowlark, lark bunting, grasshopper sparrow.

Fencerows, Road and Railroad Right-of-Ways--Eastern kingbird, Western meadowlark, brown-headed cowbird, lark bunting, vesper sparrow, Western kingbird, loggerhead shrike, common yellowthroat, red-winged blackbird, dickcissel, American goldfinch, Savannah sparrow, clay-colored sparrow, song sparrow.

Shelterbelts and Tree Claims--Eastern kingbird, Western kingbird, willow flycatcher, common crow, house wren, brown thrasher, robin yellow warbler, common grackle, American goldfinch, clay-colored sparrow, song sparrow, black-billed cuckoo, least flycatcher, bluejay, black-billed magpie, Eastern bluebird, cedar waxwing, loggerhead shrike, starling, warbling vireo, common yellowthroat, Brewer's blackbird, brown-headed cowbird, Northern oriole, orchard oriole, clay-colored sparrow,

Farmsteads--Eastern kingbird, Western kingbird, barn swallow, house wren, brown thrasher, robin starling, yellow warbler, house sparrow, common grackle, song sparrow, Say's phoebe, cliff swallow, gray catbird, Eastern bluebird, cedar waxwing, warbling vireo, common yellowthroat, brown-headed cowbird, orchard oriole, American goldfinch, chipping sparrow,

Mixed-Grass Prairie--horned lark, Western meadowlark, brown-headed cowbird, Savannah sparrow, grasshopper sparrow, Baird's sparrow, clay-colored sparrow, chestnut-collored longspur, Sprague's pipit, common yellowthroat, bobolink, red-winged blackbird, lark bunting, vesper sparrow.

Mixed-Grass-Short-Grass Prairie Ecotone--horned lark, Western meadowlark, brown-headed cowbird, grasshopper sparrow, chestnut-collored longspur, Sprague's pipit, lark bunting, vesper sparrow.

Short-Grass Prairie--horned lark, chestnut-collared longspur, Western meadowlark, brown-headed cowbird, McCown's longspur.

Black Sage Prairie--lark bunting, Brewer's sparrow, horned lark, Western meadowlark, brown-headed cowbird, vesper sparrow.

Prairie-Woodland Thickets--Eastern kingbird, willow flycatcher, brown thrasher, yellow warbler, American goldfinch, clay-colored sparrow, song sparrow, Western kingbird, least flycatcher, gray catbird, robin, cedar waxwing, loggerhead shrike, common yellowthroat, Brewer's blackbird, brown-headed cowbird.

Wet-meadow Swales--Red-winged blackbirds, Savannah sparrow, short-billed marsh wren, Sprauge's pipit, common yellowthroat, bobokink, Western meadowlark, Leconte's sparrow.

Seasonal Ponds and Lakes--red-winged blackbirds, long-billed marsh wren, short-billed marsh wren, common yellowthroat, yellow-headed blackbird, sharp-tailed sparrow.

Semipermanent Ponds and Lakes--long-billed marsh wrens, red-winged blackbirds, yellow-headed blackbirds, short-billed marsh wrens, common yellowthroat, sharp-tailed sparrow.

Permanent Prairie Ponds and Lakes--red-winged blackbird.

Permanent Wood Bordered Ponds and Lakes--tree swallows, rough-winged swallows.

Fens--short-billed marsh wren, common yellowthroat, red-winged blackbird, Leconte's sparrow, willow flycatcher, gray catbird, yellow warbler, Savannah sparrow, sharp-tailed sparrow, swamp sparrow, song sparrow.

Permanent Streams and Oxbows--bank swallows, rough-winged swallows, cliff swallows, Eastern phoebe, tree swallow, barn swallow, red-winged blackbird.

Mouse River Floodplain Forest--willow flycatcher, least flycather, common crow, black-capped chickadee, house wren, robin red-eyed vireo, yellow warbler, Northern oriole, American goldfinch, lazuli banting, clay-colored sparrow, song sparrow, bluejay, black-billed magpie, white-breasted nuthatcher, brown thrasher, gray catbird, cedar waxwing, yellow-breasted chut, brown-headed cowbird, rose-breasted grosbeak, spotted-refous-sided towhee.

Western River Floodplain Forest--least flycatcher, black-billed magpie, common crow, black-capped chickadee, robin, red-eyed vireo, warbling virwo, American redstart, ovenbird, black-headed grosbeak, lazuli bunting, spotted-rufous-sided towhee, great-crested flycatcher, willow flyca cher, Eastern wood pewee, Western wood rewae, bluejay, white-breasted nuthatcher, house wren, brown thrasher, gray catbird, veery, Eastern bluebird, cedar waxwing, Bell's vireo, yellow-throated vireo, black and white warbler, common yellowthroat, yellow-breasted chut, brown-headed cowbird, Northern oriole, scarlet tanager, American goldfinch, chipping sparrow, clay-colored sparrow, song sparrow.

Turtle Mountains Deciduous Forest--least flycatcher, common crow, verry, red-eyed vireo, warbling vireo, yellow warbler, American redstart, Northern oriole, rose-breasted grosbeak, clay-colored sparrow, great-crested flycatcher, willow flycatcher, Eastern wood pewee, bluejay, black-capped chickadee, white-breasted nuthatcher, house wren, brown thrasher, gray catbird, robin Eastern bluebird, cedar waxwing, yellow-throated vireo, Philadalphia vireo, black and white warbler, chestnut-sided warbler, ovenbird, Northern waterthrush, common yellowthroat, mourning warbler, brown-headed cowbird, chipping sparrow, song sparrow, white-throated sparrow.

Western-Upland Deciduous Forest--black-billed magpie, robin, red-eyed vireo, yellow warbler, lazuli bunting, spotted-rufous-sided towhee, least flycatcher, bluejay, common crow, black-capped chickadee, house wren, brown thrasher, gray catbird, veery, Eastern bluebird, cedar waxwing, warbling vireo, black and white warbler, ovenbird, common yellowthroat, yellow-breasted chut, brown-headed cowbird, American goldfinch, black-headed grosbeak, chipping sparrow, clay-colored sparrow, song sparrow.

Western-Evergreen Forest--black-billed magpie, house wren, Audubon's warbler, brown-headed cowbird, spotted-rufous-sided towhee, chipping sparrow, common crow, red-breasted nuthatcher, brown thrasher, robin, Brewer's blackbird, lark sparrow.

Badlands Community Complex--Say's phoebe, black-billed magpie, rock wren, mountain bluebird, loggerhead shrike, spotted-rufous-sided towhee, vesper sparrow, lark sparrow, field sparrow, Eastern kingbird, horned lark, rough-winged swallow, cliff swallow, house wren, brown thrasher, yellow warbler, yellow-breasted chut. Western meadowlark, Brewer's blackbird, brown-headed cowbird, American goldfinch, lark bunting, grasshopper sparrow, clay-colored sparrow, song sparrow.

Amphibians and Reptiles. The amphibian and reptilian faunas are meager--8 species of the former and 12 of the latter. This scarcity is attributable to the area's continental climate, primarily the extreme cold and the dryness. Low winter temperatures handicap both groups, but cold affects reptiles more than amphibians. Aridity restricts amphibians more severely because they require water for breeding and because most adults require damp habitats. The reptiles and amphibians are a most interesting and often secretive group. They serve as both prey and predator in the complex biosystem.

Amphibians recorded in the North Dakota study area include the tiger salamander, the plains spadefoot toad, the great plains toad, the Rocky Mountain toad, the Dakota toad, the chorus frog, the leopard frog, and the wood frog. Reptiles include the snapping turtle, the painted turtle, the smooth soft-shelled turtle (the latter represented by a single record from the Missouri River south of Bismarck), the sagebrush lizard (recorded from a single locality in McKenzie County, the short-horned lizard, the plains garter snake, the red-sided garter snake, the western hog-nosed snake, the racer snake, the smooth green snake, the bull snake, and the prairie rattlesnake.

Endangered Species of North Dakota. Threatened wildlife species are defined as those species or subspecies that are so few in numbers or so threatened by present circumstances as to be in danger of extinction.

The black-footed ferret formerly inhabited western North Dakota wherever there were black-tailed prairie dog towns. Currently, existence of this species in restricted locales of the State is suspected but unconfirmed.

The whooping crane formerly bred in Bottineau, McHenry, Ward, McLean and Stark Counties. The nesting population is now extirpated in North Dakota. Migrant whooping cranes stop in central North Dakota druing spring and fall migration periods.

The peregrine falcon formerly bred in Bottineau, McKenzie, Dunn, Golden Valley, Stark, Slope, and Morton Counties. It is probably extinct as a breeding bird in North Dakota. However, migrating peregrine falcons fly through the western part of the State.

The prairie falcon is known to nest in the State.

The tule white-fronted goose breeds in northern Yukon Territory and winters in Texas and Louisiana; and overflys the State in spring and fall.

Status - Undetermined Species

Burrowing Owl. This owl is fairly common on the Northwestern Drift Plain; uncommon on the Missouri Coteau and in the Southwestern Slope Region; uncommon on the Southern Drift Plain; and rare in the Agassiz Lake Plain Region and on the Northeastern Drift Plain.

Burrowing owls are especially characteristic of heavily grazed tracts of mixed-grass prairie, and locally, the closely cropped grasslands within prairie dog towns. Burrowing owls tend to concentrate in grasslands that contain colonies of large rodents, particularly the blacktail prairie dog on the Missouri Slope and Little Missouri Slope, and colonies of the Richardson ground squirrel elsewhere.

Burrowing owl nests commonly occur in the abandoned dens of large rodents. Abandoned dens of other mammals are sometimes utilized, including those of the badger. The appearance of a few nesting sites indicates that burrowing owls occasionally dig their own nest burrows.

Osprey. No definte breeding records exist for osprey in North Dakota. A few osprey pass through North Dakota during migration.

The Ferruginous hawk and prairie pigeon hawk breed in western North Dakota. The northern long-billed curlew breeds only in the southwestern part of the State. The northern swift fox inhabits the State. One was taken in 1970--the first since 1915 (BSFW, 1973). The Canada lynx inhabits the Turtle Mountains which represent the periphery of its range.

North Dakota

Fish

The study area includes most of the important sport and commercial fisheries in North Dakota that range in size from 5 to 400,000 surface acres. All impoundments are under intensive fishery management. The fishing, while variable, tends towards high quality. Catchable species include walleye, northern pike, trout, salmon, black and white bass, bluegill, crappie, and yellow perch. Approximately 187,000 active sport fishermen enjoy almost 700,000 days annually catching over 2 million fish. Approximately 60 percent of this activity occurs in the study area. The free-flowing portion of the Missouri River between the Garrison Dam and Lake Oahe is considered one of the finest sport fisheries in the Great Plains area.

Seventeen major trout lakes furnish excellent sport fishing. These lakes are stocked annually with approximately 300,000 rainbow trout fingerlings.

Lakes Sakakawea and Oahe, the two mainstem reservoirs in North Dakota, comprise a total surface acreage of about 500,000 acres, depending on water levels. Both reservoirs are excellent sport fishing areas. These areas are important not only to North Dakota anglers but receive high usage from nonresident anglers. Species present include northern pike, walleye, white bass, sauger and coho salmon. The State record for northern pike is from Sakakawea, with the highest weight of pike in excess of 20 pounds.

Lake Oahe has an excellent sport fisheries with northern pike, walleye, white bass, and sauger and coho salmon being the principal species harvested. Other species common to this reservoir include: pallid sturgeon, shovelnose sturgeon, paddlefish, shortnose gar, rainbow trout, brown trout, goldeye, carp, silvery minnow, flathead chub, golden shiner, emerald shiner, red shiner, sand shiner, fathead minnow, longnose dace, creek chub, river carpsucker, longnose sucker, white sucker, blue sucker, smallmouth buffalo, bigmouth buffalo, northern redhorse, black bullhead, channel catfish, stonecat, tadpole madtom, flathead catfish, burbot, green sunfish, pumpkinseed, orange-spotted sunfish, bluegill, largemouth bass, white crappie, black crappie, Iowa darter, yellow perch, and freshwater drum.

Lake Sakakawea is an excellent sport fishing area, with northern pike, sauger, walleye, white bass and coho salmon the main species included in the creel. Except that there are no largemouth bass, green sunfish, and longnose dace in Lake Sakakawea, resident fish in this reservoir are the same as those in Lake Oahe.

Cannonball River produces one of the best catfisheries in the State, plus walleye, sauger, and northern pike. It also serves as an excellent catfish nursery area. Other fish of this river and its main tributary, the Cedar River, include: carp, white sucker, northern redhorse, black bullhead, channel catfish, tadpole madtom, goldeye, burbot, green sunfish, pumpkinseed, white crappie, yellow perch, bluegill, silvery minnow, plains shiner, fathead minnow, paddlefish, common shiner, creek chub, blue catfish, stonecat, emerald shiner, hornyhead chub, brook stickleback, rock bass, longnose dace, orange-spotted sunfish, Johnny darter, brown bullhead, bigmouth shiner, plains minnow, brassy minnow, and Iowa darter.

The North Fork of the Grand River is used mostly by spawning northern pike. Other species present include rainbow trout and most species present in the Cannonball River.

The Heart River, in the eastern part of Billings County, flows in an erratic easterly direction to its confluence with the Missouri River below Mandan. The river meanders through a valley about a half-a-mile in width, with two major reservoirs on the main stem. They are Edward Arthur Patterson Lake (24,000 acre feet) and Lake Tschida (430,000 acre feet). Sweetbriar Reservoir (3,320 acre feet) on Sweetbriar Creek is the only reservoir on a major tributary. Numerous reservoirs on smaller tributaries are used for stock watering and recreation use. The Heart River above Heart Butte Dam has a limited population of sport fishes. An excellent sport fisheries exists for walleye, northern pike, catfish, and white bass, below Heart Butte Dam to the Missouri River. Other species include rainbow trout and most species common to the Cannonball River.

The Knife River originates in northwestern Billings County and flows easterly to its confluence with the Missouri River at Stanton, North Dakota. The headwaters area in badland topography, includes a part of the Killdeer Mountains, while the middle and lower reaches of the river drain gently rolling topography. Spring Creek, the major tributary, drains 582 square miles. Sport fishing in the Knife River is confined to the lower reaches, with walleye and northern pike being the principal sport fishes.

The Little Missouri River heads in northeastern Wyoming, flows through southeastern Montana and northwestern South Dakota, and enters the extreme southwestern corner of North Dakota. Its drainage area is 9,500 square miles, of which 4,750 square miles lie in North Dakota. The stream channels are cut in easily eroded shales and sandstones of the badlands, and transport large loads of sediment. The Little Missouri River functions chiefly as a catfish nursery area and provides excellent catfisheries. Northern pike, sauger, and walleye, and other species common to the area are present.

The free-flowing portion of the Missouri River between the Garrison Dam and Lake Oahe is considered one of the finest sport fisheries in the Great Plains area. Species include: paddlefish, pallid sturgeon, shovelnose sturgeon, shortnose gar, goldeye, gizzard shad, brown trout, rainbow trout, northern pike, blue sucker, river carpsucker, northern redhorse, white sucker, bigmouth buffalo, smallmouth buffalo, carp, channel catfish, flathead catfish, black bullhead, tadpole madtom, white crappie, black crappie, largemouth bass, orange-spotted sunfish, bluegill, longear sunfish, pumpkinseed, sauger, walleye, yellow perch, freshwater drum, and burbot.

South Dakota

Big Game

Historically, a large variety of big game animals, including buffalo, elk, bighorn sheep, mule deer, and white-tailed deer inhabited western South Dakota. Currently, competition with the livestock economy has essentially eliminated the buffalo, elk, and bighorn sheep. White-tailed deer, mule deer, and antelope are presently managed throughout the area.

White-Tailed Deer and Mule Deer. Both species occur throughout the area. The white-tailed deer is found chiefly in wooded river bottoms, creeks, and croplands. The mule deer is most abundant in extensive grassland areas with rugged terrain and deep draws, having scattered patches of brush and trees. The mule deer is dominant because the overall terrain and floristic range composition favors his habitat requirements. Deer management is affected chiefly by landowner tolerance and weather. Drought adversely affects forage and subsequent winter survival. The current population is at one of its highest levels, and the trend is toward increasing numbers. This trend is shown in permits available in 1972 (6,926) and in 1973 (8,320). The area is extremely popular for deer hunting, and its esthetic features equal the hunting experience. Key areas of outstanding quality for deer encompass the Cave Hills, Short Pine Hills, and the Slim Buttes. Harding County, in which these key areas occur, is estimated to have a population of 7,000 deer.

Antelope. Prior to 1800, more than 700,000 antelope ranged the prairies of South Dakota. This vast herd formerly ranged over the entire State, but was eventually reduced to about 700 animals located chiefly in a few northwest counties of the study area. Under intensive management, the herd has now increased to the current level of about 33,000. Antelope are widely distributed, but abound in the western part of the study area. Suitable range for antelope contains not less than 900 square miles of contiguous rangeland, with not more than 5 percent of the area under cultivation. The topography must afford winter protection and adequate browse to support antelope under blizzard conditions. The antelope is a browser of such woody plants as silver

sage and big sage, and forbs. Factors influencing antelope abundance are food supply, weather conditions, predation, crop damage, forage competition with domestic livestock, sheep-tight fences, parasites and disease, hunting, and accidental mortality. A total of 4,850 hunting permits were issued in the area in 1972, and hunting success was 90 percent. Sixty-five to 70 percent of the annual Statewide permit allocations are within the study area.

Upland Game Birds and Mammals

Ring-Necked Pheasant. Pheasant habitat of high quality is restricted to cropland areas. Major limiting factors are winter food and cover. Areas of key importance are in the vicinity of Shadehill Reservoir and Timber Lake. Pheasant hunting is limited in the area; however, about 2,700 hunters take about 5,000 birds annually. The species contributes variety to the wildlife abundance of the area. The population trend is stable.

Sage Grouse. The sage grouse exceeds all other North American grouse in size. Observing their unusual breeding display is the recreational pursuit of many people. Habitat requirements are probably as specific as for any kind of wildlife. Population abundance and distribution are almost exclusively determined by the amount and quality of sagebrush ranges. The primary range is exclusively within the approximate west one-half of the study area. Populations have varied between 5,000 and 8,000 in recent yaars. Hunting is conducted on a limited basis by approximately 350 hunters.

Sharp-Tailed Grouse. Sharp-tailed grouse are found throughout the study area. The highest populations and best habitat occur in the eastern one-half of the area. Habitat consists of mixed prairie grasses and forbs, shrubs, and trees. Shrubs and trees constitute only a small percentage of the vegetation, but are essential. Rolling hills, river breaks, and wooded draws are also important elements of high quality habitat. Grouse populations are cyclic. The present population, one of the highest in recent years, is expected to decline during the next few years. Approximately 7,000 hunters take 35,000 grouse annually in the study area. Grouse hunting is extremely popular with both residents and nonresidents. Limiting factors are habitat, weather, predation, parasites, and accidents; but the most significant is habitat.

Pinnated Grouse (Prairie Chicken). Discussed under "Threatened and Endangered Wildlife."

Hungarian Partridge. The Hungarian partridge is an exotic game bird, introduced in South Dakota during the mid-1920's. The best habitat is associated with grain-growing areas having scattered, brushy cover and grassland. The Hun is considered a "bonus" bird in connection with the hunting of more abundant game birds. About 1,200 hunters harvest 1,500 Huns within the study area. Although limited in distribution and abundance, the Hungarian partridge is a prize in the bag of the hunter and a welcome occupant on the property of the landowner.

Chukar Partridge. The chukar partridge is an exotic, introduced in South Dakota in the early forties. Reproduction appears to be limited. Population numbers are low and considered to be stable or decreasing. The area in Harding County is classified as a key unit on the basis of the 1960 stocking effort and the continued presence of the chukar partridge.

Merriam's and Rio Grande Turkeys. Merriam's turkey was introduced successfully in the Black Hills in 1948, and transplanting to suitable prairie sites was initiated in 1958. Rio Grande turkeys were stocked on the Little Moreau south of Timber Lake in the early sixties. Transplants were successful at or near Slim Buttes, Short Pines, Cave Hills, Cedar Canyon, Grand River, and Shadehill Reservoir; and limited hunting seasons have since been held. Breeding stock exists at most of the sites, and appear to be expanding. The best habitat is characterized by a preponderance of ponderosa pine with a mixture of grassland, brush, and deciduous trees located in rough terrain. Demand for turkey hunting is high, and the value of the habitat will increase with time.

Cottontail Rabbit. The cottontail is widely distributed and is abundant throughout the study area. Populations are highest along river bottoms and breaks and in butte areas where brush and other vegetative cover is common. Populations fluctuate periodically, but remain at a level which affords a popular winter hunting pastime and food item. The cottontail is probably the most widely utilized small game animal in the study area. It is a prey species for all predatory birds and animals.

White-Tailed Jackrabbit. The jackrabbit chiefly dwells in the open prairie, and is abundant in most of its range. Populations show periodic fluctuations but are usually sufficient to be regularly hunted for sport during the winter months. The carcasses have been valued as mink food and the fur for commercial purposes. The jackrabbit is an important prey species for predatory birds and animals.

Red Squirrel. The red squirrel is mostly limited to the areas having fair-to-good stands of pine, such as the Short Pines, Cave Hills, and Slim Buttes areas. Their esthetic value is high and occurrence unique to the study area.

Fox Squirrel. This squirrel is confined to river bottoms and connecting drainages where trees and other woody plants occur in abundance. Farmsteads with shelterbelts are sometimes occupied by one or two pairs of fox squirrels. Although hunted occasionally for sport and food, their value is chiefly esthetic.

Waterfowl. Western South Dakota and the Missouri River have been traditional spring and fall migration areas for ducks, geese, swans, and mergansers. Many thousands of livestock watering ponds constructed in the past thirty-five years, combined with natural wetlands, account for 30 to 35 percent of total duck production in South Dakota. Some of these ponds are also used by nesting Canada geese.

Ducks. The most important ducks in the study area include blue-winged teal, mallard, pintail, shoveller, gadwall, and baldpate (American widgeon). Wood ducks occur along the major streams in limited numbers. Common migrants are green-winged teal, redhead, lesser scaup, ruddy ducks, and bufflehead. Occasional migrants include canvasback,

greater scaup, cinnamon teal, ringnecked duck, and American or common goldeneye. Numerous livestock ponds throughout the area constitute the primary breeding habitat. This habitat is supplemented by some natural wetlands of high quality, the rivers, and several large water impoundments. Key areas are Belle Fourche and Shadehill Reservoirs and the Timber Lake area. Population trends show an increase. Duck hunting, although important to the local hunter, does not attract any substantial number of outside-area hunters.

Mergansers. Three species occur in the study area. The American, red-breasted and hooded mergansers are common migrants. The hooded merganser has been observed as a rare nester. The culinary values of the merganser are poor, thus very little attention is given the species by the hunter. However, they are all of high esthetic value.

Geese. Four species of geese are seasonal occupants of the study area. Migrant populations of white-fronted, snow, blue, and Canada geese move through the area in spring and fall. The blue goose is only rarely observed. The giant Canada goose is the object of an intensive restoration program in western South Dakota. A captive flock just below Shadehill Reservoir is one source of stock for transplants in the study area. Twelve releases, totaling 300 geese, have been made in Perkins, Corson, Meade, and Harding Counties. A reported 150 wild goslings were produced within 75 miles of Shadehill Reservoir in 1973. The Missouri River and adjacent uplands are of primary value during migration periods. Goose hunting at the present time, other than in the vicinity of the Missouri River, has only local interest and minimal yield.

Swans. The whistling swan is an occasional migrant, and the trumpeter swan a rare migrant to the area. Trumpeter swan observations may be of birds originating from the trumpeter swan restoration flock at Lacreek National Wildlife Refuge near Martin, South Dakota. Both species are of high esthetic value, and the trumpeter is of particular interest as a rare species currently managed in a restoration project.

Cranes. (The whooping crane is discussed under "Endangered Wildlife.") Three different cranes can be observed within the study area: whooping crane, sandhill crane (little brown crane), and greater sandhill crane. The lesser sandhill crane is more numerous with only a rare occurrence of the larger greater sandhill crane. Spring and fall migrations exceed 100,000 cranes in total numbers moving through the area. The sandhill crane, being primarily an upland feeder, depends upon the forage plants, animal life, and waste grain available on the prairie. A brief hunting season is held each fall in the extreme eastern part of the study area.

Aquatic Furbearers. Major aquatic furbearers of the area are beaver, muskrat, and mink. The beaver and muskrat normally occur along major river drainages and at stock ponds. Stock ponds having willow and other succulent woody plants and an abundance of emergent aquatic plants are likely to support beaver. Although normally associated with water, the mink is readily found on the uplands. All three species commonly occur throughout the study area. Population trends appear to be stable or increasing. Annual fur-sale values are estimated to be about $18,000. Trapping is a source of supplemental income to residents.

Coyote. Essentially, the entire study area is high quality coyote habitat. Extensive remote areas of gently rolling to rugged terrain, with an abundance of wild and domestic prey, present an ideal environment for the crafty coyote. Estimated annual fur value is $16,000. The coyote is presently abundant and increasing in numbers.

Bobcat. The bobcat occurs throughout the study area. They are most common in the breaks of river drainages and other rugged terrain having abundant or scattered patches of woody cover and an abundance of prey. Although, relatively common and with a present high fur value, the harvest has been low; but more trappers are turning attention to the bobcat.

Red Fox. The red fox is widely distributed and abundant throughout the area. They prefer a diversified environment--topography, vegetation, animal and bird life, and land use. No population estimate is available, but numbers are believed increasing. Commercial demand for pelts is high and pelt value is stimulating a substantial increase in trapping.

Other Furbearers and Non-Game Mammals

The badger, raccoon, striped skunk, and weasel occur throughout the area. Populations of individual species vary locally. In farming areas raccoon numbers are high and the skunk is a regular resident. It is estimated that fur buyers will annually handle pelts of these species valued at a minimum of $25,000. The spotted skunk and porcupine are also indigenous to the area. Their value is chiefly esthetic.

Black-Tailed Prairie Dog. The prairie dog continues to be widely distributed in the study area, but numbers have substantially declined. Prairie dogs live in colonies which are commonly located on native grassland flats along intermittent drainages they can be found on most flats with good drainage. Grasses and forbs comprise most of their diet. Insects are a small part of their diet. The prairie dog serves as an important food item for such mammalian and avian meat eaters as coyote, fox, badger, black-footed ferret, eagles, hawks and owls. The prairie dog is a hearty eater, and will keep most vegetation closely cropped. Key significance is attached to the prairie dog in his relation to the black-footed ferret. The prairie dog town is the principal natural habitat of the black-footed ferret. Prairie dog populations are at a moderate level, and are increasing.

Small Mammals. Small mammals in the study area include mice, voles, shrews, native and introduced rats, ground squirrel, chipmunk, gopher and bats. Most species have wide distribution and are an integral part of the biota of the area. This report contains a list of mammals in the study area.

Non-Game Birds

Mourning Dove. The mourning dove is widely distributed and relatively abundant. River bottom areas are particularly attractive. They nest in trees and on the ground. The dove population in South Dakota is one of the highest of the Western States, and is stable or increasing in numbers. Hunting the mourning dove was stopped by referendum. The esthetic value of the dove is rated extremely high.

Golden Eagle. The golden eagle is quite common throughout the study area. Thirty-five active nests have been observed and up to 30 young have been produced in the area. A minimum nesting density is found in the Cave Hills, Slim Buttes, and Short Pines areas. Aeries can be found in trees, on precipitous cliff ledges of buttes, or on prominent rock outcrops on the open prairie. A pair returns to the same site each year, adding new material each year until the nests are huge. Current national concern is high for the future of this large bird of prey. The population trend is a gradual decrease.

Bald Eagle. The bald eagle is occasionally observed throughout the area, from the Missouri River to the western boundary of South Dakota. The bald eagle is normally found in areas having rivers or other water as a source of their favorite food--fish. They have been observed to feed on mammalian prey in the winter. The bald eagle is a rare nester in the area. The value of each one observed is extremely high.

Turkey Vulture. The turkey vulture is a common summer resident of the area. Although not abundant, they are regularly observed feeding on all forms of carrion. The butte and river areas are the most frequent locations of activity. The vulture is the sanitarian of the prairie.

Hawks, Falcons, and Owls. This group of birds of prey is a listing of individuals not discussed elsewhere in this report. It includes the goshawk, sharp-shinned hawk, Coopers' hawk, red-tailed hawk, Swainson's hawk, rough-legged hawk, Ferruginous hawk, broad-winged hawk, Harlan's hawk, marsh hawk, prairie falcon, sparrow hawk, barn

owl, saw-whet owl, and the long-eared owl. The variety of this group attests to the diversity of the habitat and abundance of prey species. Population trends for the area--although open to conjecture--are fundamentally undertermined at this time. The value of the group is undeniably high as both a factor in influencing levels of small prey populations and as a strong contributor to esthetics.

Other Birds. This group includes the loon, grebes, cormorant, herons, pelican rails, coot, shorebirds, gulls, terns, pigeon, cuckoos, nighthawk, goatsuckers, swift, hummingbird, kingfisher, woodpecker, flycatchers, larks, swallows, jays, magpie, crow, chickadee, nuthatches, creeper, wrens, thrashers, thrushes, kinglets, pipits, waxwings, shrikes, starling, vireos, warblers, weaver finch, blackbirds, orioles, tanagers, finches, and sparrows which occur in the study area. One hundred and ninety-five species have been reported. A population appraisal is impractical for this many species. Some species have very limited habitat; the limiting factors may be vegetation, terrain, or a combination of both. This large, diverse group of birds has recreational and high esthetic values. This report contains a list of birds of the study area.

Amphibians and Reptiles. A tentative checklist included the following 24 species: tiger salamander, plains spadefoot toad, leopard frog, great plains toad, Woodhouse's toad, American toad, cricket frog, chorus frog, snapping turtle, western painted turtle, Lesuerur's terrapin, western spiny softshell, prairie lizard, short-horned lizard, six-lined racerunner, prairie skink, garter snake, plains garter snake, western hognose snake, black racer, smooth green snake, bullsnake, milk snake, and prairie rattlesnake. Habitat requirements of each group depend upon terrain and such physical features as water and vegetation. Some species are highly sensitive to certain elements in their required environment during life processes. An example is metamorphosis of the frog. Few species are popular with the general public, but all are of significance to the biotic community and select fields of science.

Threatened and Endangered Wildlife. Species endangered with extinction significant to the study area are American peregrine falcon, whooping crane, and black-footed ferret. Observations of the peregrine falcon usually occur during spring or fall migration. As a rare summer resident, no recent observations have been found on record for the study area. High vertical cliffs, as found in the buttes area of Harding County, may conceivably satisfy the nesting requirements of the species.

The whooping crane is a regular fall or spring migrant. The population totaled 80, including wild birds and 21 in captivity, in the winter of 1971-72. The study area is important as a part of the migration route of the whooping crane. The remoteness of this segment of the migration route may contribute to reducing the losses by illegal shooting.

Black-footed ferrets have been observed in most of the study area, closely associated with the prairie dog towns (colonies); their multitude of ground burrows are his principal natural habitat. The present population level is unknown. However, the wide distribution of prairie dog towns in the area implies excellent potential to improve the population of the ferret.

Species which are considered threatened with extinction but not on the endangered list include the northern greater prairie chicken and the prairie falcon. The prairie chicken is a rare resident of the area. Some small scattered groups still remain, and active dancing grounds can be observed. The best habitat consists of good stands of native mid-to-tall grasses occurring in conjunction with some cropland. The grasses should be 60 to 70 percent of total ground cover composition. A very few prairie chickens are harvested in locales where their populations are not endangered, but their value is chiefly esthetic.

The prairie falcon is a common resident. It is a cliff nester, and butte areas comprise important habitat. In 1973, 25 nests were located in the butte areas of Harding County.

Six birds and one mammal are listed as status undetermined: ferruginous hawk, American osprey, prairie pigeon hawk, mountain plover, northern long-billed curlew, western burrowing owl, and northern swift fox. The ferruginous hawk is fairly common to the area. Nesting occurs primarily on the plains and in trees, and occasionally in the buttes.

Occurrence of the osprey is rare. One recorded observation is for Shadehill Reservoir in Perkins County; all others have been in the immediate vicinity of the Missouri River. Osprey habitat is essentially confined to the Missouri River and mouth of tributary rivers which have an available supply of food-fish and nesting sites.

The prairie pigeon hawk is an uncommon resident to the area. Nests have been found in the butte areas of Harding County

Recorded observations of the mountain plover could not be found for the study area; however, the species may migrate along the western boundary.

The northern long-billed curlew is fairly common as a nester. Localities with alkaline soils and associated natural vegetation in sparsely settled areas are preferred habitat for summer nesting and residence.

The western burrowing owl can be observed on essentially every prairie dog town. Although this owl uses a variety of ground burrows, the preferred habitat is the burrows of prairie dog towns.

The northern swift fox is present in the study area, but in very low numbers. This small fox is a plains dweller. The reasons for the current low population are undetermined. They are easily trapped, but it is doubtful this single factor would constitute a major decimating influence.

Other unusual mammals in the area are the wolverine, Canada lynx, and mountain lion. Mountain lions have been recently reported on the Moreau River northeast of Lantry in Dewey County, and tracks have been identified near Shadehill Reservoir in Perkins County.

South Dakota

Fish

The Grand River provides the most significant fishery resource in the South Dakota study area. The South Fork of the Grand River, characterized by high annual fluctuations in flow and a heavy silt load, arises in western South Dakota and flows easterly along the northern part of the State. Shadehill Reservoir, at the junction of the North and South Forks of the Grand River, is subject to wide annual fluctuations in water level, shoreline erosion, and wind and wave action that result in relatively high turbidity and an absence of rooted aquatic vegetation. The reservoir has 5,500 surface acres of water at maximum pool level. Maximum depth is 67 feet, and average depth is 20 feet.

The flow downstream from Shadehill Reservoir to the Missouri River depends upon precipitation and releases from Shadehill. Portions of the Grand River, including Shadehill Reservoir, contain light-to-moderate populations of fish species, including walleye, channel catfish, rainbow trout and brown trout, yellow perch, and northern pike. Extremes in flow rates, extended periods of no flow, and the unstable, silted streambed, limit fish populations in the South Fork of the Grand River. Some migration upstream from Shadehill Reservoir occurs, but the resident population is primarily channel catfish.

Shadehill Reservoir contains moderate populations of walleye and channel catfish and has small populations of yellow perch, crappie, bluegill, northern pike, white bass, and black bullhead. It slso contains large populations of carpsucker, carp, and northern redhorse. Largemouth buffalo, green sunfish, goldeye, stonecat, flathead chub, golden shiner, and common sucker also occur. The tail-water area below Shadehill Reservoir attracts large numbers of many species of fish, including substantial numbers of walleye, channel catfish, and, at times, northern pike. Rainbow trout or brown trout are stocked in the tail-water area. Limited fish populations and sport fisheries exist in the Grand River downstream from the tailwater area of Shadehill Reservoir.

Populations of several species of fish in Oahe Reservoir depend upon reproduction in such tributaries as the Grand River. Fish are attracted into the tributaries in the spring by high flows of warmer water, and spawning is then triggered by rising water levels.

Recreational Use of Fishery Resources. Use along the Grand River is characterized as very light to moderate along the entire course, including Shadehill Reservoir. Fish populations, turbidity, and fluctuating water levels are not attractive to users from out of the basin.

Shadehill Reservoir, an important regional fishing area, has changed in species composition and impoundment waters, and fisherman use has declined. Management practices are being revised to improve the fishery resource. Present water availability is critical to the existing fishery resource. Further depletions of water would adversely affect the fishery resource in the Grand River and the Oahe Reservoir. The fishery resource of Lake Oahe in South Dakota is identical to that reservoir's resource in North Dakota.

Wyoming

Big Game

The NGPRP study area encompasses much of the best mule deer and antelope habitat in Wyoming. Both deer species and antelope in eastern Wyoming constitute a hunting resource of national significance. In eastern Wyoming nonresident hunters outnumber resident hunters for these species. In 1970, 43,000 nonresidents hunted deer in the study area of Wyoming.

Mule Deer. Mule deer are found throughout the study area. Highest populations are in moderately timbered areas and rough river breaks; as opposed to lower populations on large unbroken prairie lands, alpine and subalpine spruce-fir forests, and sagebrush-grasslands where water is scarce. They migrate in fall and winter from summer range in high timbered areas in the Big Horn Mountains to winter range in the foothills and valleys along the east face of the mountains. The foothills of the Laramie Mountains are critical winter range for mule deer. Mule deer populations have stabilized at or near carrying capacity. Two-deer limits have been used recently in northeastern Wyoming to control deer populations. Liberal nonresident hunting regulations keep most deer herds in check. Oil field development has eliminated some habitat. In 1970, approximately 87,000 mule deer were harvested, resulting in an average hunter success of 75 percent. This was an extremely high harvest year. Almost half of all deer harvested in Wyoming were taken in the NGPRP study area, and 70 percent of the hunters were nonresidents.

White-Tailed Deer. Large numbers of white-tailed deer inhabit the Black Hills of northeastern Wyoming, where mule deer populations are also good. Whitetails abound in the Tongue and Powder River bottoms and along the east face of the Big Horn Mountains. Some small whitetail populations occur scattered over the study area. In the Black Hills, white-tailed deer migrate 20 miles from high summer range to lower winter range. Here, bur oak, alfalfa, and Oregon grape are important plants in their yearly diet (Roby, 1972). Whitetail populations are high within their range, and population trends

are upward. Fawn production is consistently excellent. Whitetail distribution appears to be increasing along the Powder River and some streams of eastern Wyoming. Over 10,000 whitetails were harvested in northeastern Wyoming in 1970; in 1972, over 10,000 whitetails were harvested in Crook County alone. Much hunting pressure is exerted by nonresidents.

Pronghorn Antelope. In 1970, approximately 46 percent of the estimated world population of pronghorn antelope inhabited Wyoming; one-fourth were in the study area. Most of Wyoming's antelope occur on either sagebrush steppe and saltbush-greasewood ranges or on grama-needlegrass-wheatgrass ranges (Sundstrom, Hepworth, and Diem, 1973). Forage species utilized by antelope are sagebrush, rabbitbrush, and sagewort. In eastern Wyoming, forb use is high in spring, declining in fall and winter; grass use is minimal. Populations decreased slightly in the late 1960's in Campbell and eastern Sheridan Counties, attributable to loss of habitat caused by surface developments as a result of fuel exploration and production. Antelope populations have increased significantly in most of eastern Wyoming, and the area's population is now stabilized. In 1970, more than half of the antelope harvested in Wyoming were taken in the study area. Hunter success rate was 93 percent. Usually, nonresident hunters outnumber resident hunters.

Elk. A large population of Rocky Mountain elk inhabit the Big Horn Mountains in the northeastern portion of the Wyoming study area and the high Laramie Range to the south. Small, but important, elk herds are found in the Black Hills, the Fortification Area of the Powder River breaks in Campbell County, the Rawhide Butte area of southern Niobrara County, the Pedro Mountains south of Alcova Reservoir, the Rattlesnake Hills of Natrona County, and along the southern Campbell-Weston County line. With the exception of the latter, all of these herds provide hunting. The Big Horn and Laramie Mountains' elk herds migrate annually from high elevation summer range to restricted and critical lower elevation winter range. The Black Hills' elk herd wanders freely between South Dakota and Wyoming. Grasses are the

prime constituent of the elk's diet, but seasonally, forbs and shrubs are important (Kufeld, 1973). Elk often compete for food with domestic livestock and, in the Black Hills, with white-tailed deer. Elk herds in the study area are managed at present levels; the populations are stabilized. The study area provided about 14 percent of Wyoming's elk hunting resource in 1970. Few nonresidents hunt elk in the area.

Bighorn Sheep. Small populations of bighorn sheep inhabit the Laramie and Big Horn Mountains and Inyan Kara Mountain in the Black Hills. Bighorns were hunted in 1973 only in the Laramie Mountains. This population is still increasing. The Inyan Kara sheep were transplanted there in 1969 and occupy a small range. The status of sheep populations in the Big Horn Mountains is unknown.

Moose. A small herd of Wyoming moose inhabits the northern Big Horn Mountains, primarily in the Goose Creek and Tongue River drainages. These animals inhabit the spruce-fir and subalpine zones and frequent brushy stream bottoms and meadows. Browse--primarily willow--is the major constituent of their diet. Moose habitat in the Big Horns is limited. Some has been eliminated by construction of small reservoirs in mountain meadows. The Big Horn moose population, stable and hunted for the last several years, has recently shown a downward trend. Illegal hunting and loss of habitat may be factors. It is questionable whether this population could survive if additional habitat were destroyed.

Black Bear. Black bear inhabit the Laramie Mountains and are common in the Big Horn Mountains. The northern Big Horn Mountains provide excellent black bear habitat, and populations are increasing. Bear numbers have been controlled to prevent livestock depredations. Black bears are lightly hunted Statewide. The study area sustained about 15 percent of the 1970 hunting pressure in Wyoming.

Upland Game

Principal upland game species of northeastern Wyoming are the sage grouse, wild turkey, ring-necked pheasant, and cottontail rabbit. Wild turkey populations of the Black Hills, and the hunting they provide, are an especially notable resource. Other upland game species inhabiting the study area of Wyoming include blue and ruffed grouse, sharp-tailed grouse, Hungarian and chukar partridge, and the snowshoe hare. Except for turkey and pheasant, upland game animals of this area are lightly hunted.

Blue Grouse. Blue grouse inhabit the lodgepole and ponderosa pine and Douglas-fir forests and subalpine zones of the Big Horn and Laramie Mountains. The primary constituents of this bird's year-round diet are Douglas-fir needles and seeds. Because populations of blue grouse are widely scattered over high country, with difficult access, this bird is lightly hunted in Wyoming. Thirty percent of blue grouse harvested in Wyoming in 1971 were taken in the study area.

Ruffed Grouse. Ruffed grouse inhabit mixed conifer-deciduous forests of the Big Horn Mountains and the Black Hills. No legal hunting occurs in the Black Hills, and ruffed grouse are only lightly hunted in the Big Horns.

Sage Grouse. Sage grouse are widely distributed throughout the study area of Wyoming, being absent only from the high forests of the Big Horn Mountains. Populations are highest wherever large expanses of sagebrush occur. Populations are low and scattered over areas of open forest and grassland prairie. This bird's diet consists almost entirely of sagebrush. Critical areas for sage grouse are their strutting grounds, brooding areas, and winter concentration areas. Here the birds depend heavily on sagebrush. Sagebrush eradication programs, intensified farming, and livestock grazing have eliminated sage grouse habitat. Current populations on remaining habitat are stable. Hunting seasons are short and hunting pressure light, so only a minor portion of the total State sage grouse harvest occurs in the study area. However, hunting interest in this grouse is increasing and most populations could support a greater harvest.

Sharp-tailed Grouse. Sharp-tailed grouse inhabit the prairie grasslands of northeastern Wyoming. They are found in the northern and eastern counties of the study area. Since 1969, these populations have increased and their range appears to be increasing to the south and west. All Wyoming sharp-tailed grouse hunting occurs within the study area. Both hunting pressure and harvest are increasing.

Ring-Necked Pheasant. Large numbers of ring-necked pheasants inhabit agricultural lands of Sheridan and Johnson Counties of Wyoming. Some of these exotic game birds also inhabit stream bottomlands in the northeast corner of the State, and they occur along the North Platte and Niobrara Rivers. Intensified farming has eliminated much pheasant habitat in recent years, and populations are declining. Nevertheless, almost as many pheasants as sage grouse were harvested in Wyoming in 1971, and over 30 percent of these were taken in the study area.

Hungarian Partridge. Hungarian partridges have been observed throughout the entire study area of Wyoming at all elevations and in a variety of habitat types. The Wyoming population consists of small, widely scattered flocks--except in the cultivated areas of Johnson and Sheridan Counties where the birds are more numerous. Wyoming's annual Hungarian partridge harvest is low; over half of the 1971 harvest occurred in the study area.

Chukar Partridge. Moderate chukar populations are well established in the foothills of the Laramie Mountains, in the southern Big Horn Mountains and a few other small areas. Better chukar habitat is found in the southeastern part of the State; only a small part of Wyoming's chukar harvest is taken in the study area.

Turkey. Introduction of Merriam's turkey to northeastern Wyoming has been extremely successful. A large population of turkeys inhabits the Black Hills, and moderate populations inhabit the Laramie Mountains and the Hat Creek Breaks and Rawhide Buttes in the southeastern part of the study area. Small populations are found in the foothills along the east face of the Big Horn Mountains and along portions of the Powder and Cheyenne Rivers and their tributaries. This large bird is

most abundant in open ponderosa pine forests in rugged terrain. Turkey populations have been increasing since 1967. In 1972, 1,184 turkeys--about 90 percent of the State total--were harvested in the Black Hills. In 1973, 3,100 permits were available for fall turkey hunting in the study area.

Cottontail Rabbit. The cottontail rabbit is classified as a small game animal in Wyoming, and hunting of this species is becoming increasingly popular. Two species of cottontail inhabit the Wyoming study area. The mountain cottontail is found in forested areas and the desert cottontail inhabits open desert and prairie. A third species, the eastern cottontail, may inhabit the extreme southeastern corner of the study area. More than 40,000 cottontails were harvested in the study area in 1971.

Snowshoe Hare. Snowshoe hares inhabit the lodgepole pine and spruce-fir forests of the Big Horn and Laramie Mountains. Hare populations are cyclic and this species is only lightly hunted.

Mourning Dove. Mourning doves nest in most of eastern Wyoming. Nesting densities are highest along wooded river bottomlands and lightest in dense timber areas. Doves rarely nest at high elevations. The mourning dove was recently reclassified as a game bird, and the legal hunting season reopened in 1973.

Waterfowl

In the spring and fall, hundreds of thousands of ducks and thousands of geese and sandhill cranes migrate through the study area of Wyoming. Ducks and geese winter at open waters in the area. Thousands of stock ponds, small reservoirs and small mountain lakes interspersed throughout the study area, provide excellent spring and summer waterfowl production habitat.

Ducks and Mergansers. In 1971, there were approximately 150,000 breeding pairs of ducks nesting in the central flyway of Wyoming. The study area comprises slightly less than one-half of this flyway in the State. Over half of the breeding ducks were mallards and American widgeon. Other duck species nesting in large numbers includ

gadwall, green-winged teal, blue-winged teal, pintail, and shoveller. Other nesting ducks include redhead, lesser scaup, ring-necked duck, goldeneye, bufflehead, and ruddy duck. In addition, about 2,000 pairs of common mergansers nest in the flyway. Scaup, canvasback, cinnamon teal, American merganser, and occasionally, wood ducks migrate through the area. Ducks nest on almost all small water bodies and large streams and rivers up to elevations of 9,000 feet above sea level. Few of these nesting ducks except mallards winter in Wyoming. Several thousand mallards and a large number of green-winged teal, goldeneye, and mergansers winter on the few rivers which do not ice over, such as the North Platte downstream from Glenrock, the Tongue near Sheridan, and a small length of Sand Creek in Crook County. In 1971, Wyoming hunters harvested 80,000 ducks which is only a small portion of those produced in the State annually. Twenty-two percent of the harvest occurred in the study area. Mallards usually comprise more than half of this harvest.

Geese. Canada geese breed in, migrate through, and winter in the study area of Wyoming. Snow, white-fronted and blue geese migrate through the area in spring and fall in small numbers. About 30,000 Canada geese migrate north through the central flyway of Wyoming in the spring and about 20,000 migrate south in the fall. Approximately 3,000 winter in the Wyoming central flyway. Some of the wintering geese concentrate on the North Platte River downstream from Glenrock where the river does not freeze over. Two to three thousand geese are harvested annually in Wyoming and only a minor portion of the harvest occurs in the study area. Goose hunting in northeastern Wyoming is currently regulated to build up the population of resident birds. Only a few hundred geese nest on the many stock ponds and small reservoirs in the study area now, and these are largely progeny of transplanted goslings. Many of the ponds and small lakes in the study area are considered potential goose production habitat.

Cranes. From 80,000 to 100,000 lesser sandhill cranes migrate south through the eastern half of the study area of Wyoming annually. Keyhole Reservoir serves as a resting area for those large birds. Limited hunting for sandhill cranes occurs in Wyoming south of the study area. Whooping cranes, an endangered species, are not known to overfly northeastern Wyoming.

Swans. Whistling swans fly south each fall through the center of the study area of Wyoming. They generally number less than 100. Rest areas regularly used include Lake DeSmet, a refinery pond north of Casper, and the North Platte River.

Non-Game Wildlife - Mammals

Furbearers. In Wyoming, mink, fisher, marten, river otter, beaver, and badger are classified as fur-bearing animals. The muskrat is not classified. Mink, beaver, and muskrat inhabit rivers, streams, ponds, lakes, and marshes, and are widely distributed. Marten inhabit the forested mountains where their prey--the red squirrel--is found. They are common in the Big Horn Mountains. Several thousand muskrat and beaver are trapped in Wyoming each year. A few hundred mink and less than 100 marten are annually taken in the State. The badger is widely distributed and hundreds of pelts are sold annually in Wyoming.

The coyote, bobcat, and red fox inhabit the entire study area. Coyotes are abundant everywhere. Bobcats are widespread, but are not abundant. Red fox numbers increase each year, and this species appears to be extending its range westward.

Other mammals classified as predators in Wyoming include the weasel, raccoon, porcupine, and jackrabbit. The long-tailed weasel is common, while the short-tailed weasel inhabits only the forested Big Horn and Laramie Mountains. The least weasel occurs rarely in the study area. Raccoons are most abundant along river and large stream bottomlands at moderate elevations. The porcupine is widely distributed throughout forested and lightly forested areas. The white-tailed jackrabbit is cyclicly abundant throughout the area, while the black-tailed jackrabbit occurs only in the southeast corner of the study area. The jackrabbit is widely hunted in Wyoming for its hide, used in glove manufacture, and its meat, fed to captive carnivorous furbearers.

The Canada lynx is a rare inhabitant of the Big Horn Mountains, and is occasionally reported throughout the rest of the study area. The striped skunk is common almost everywhere.

Red or pine squirrels are numerous in the forested Big Horn and Laramie Mountains and the Black Hills. Fox squirrels inhabit a few of the cities in the study area where deciduous trees are numerous. The northern flying squirrel inhabits the mountains, but is not generally observed because of its nocturnal habits. The Richardson

ground squirrel and thirteen-lined ground squirrel are common throughout most of the study area, except the high mountains which are inhabited by the golden-mantled ground squirrel. Black-tailed prairie dogs are widespread. White-tailed prairie dogs inhabit the southwest corner of the study area. The mountains are inhabited by the bushy-tailed wood rat, mountain phenacomys, red-backed vole, water vole, long-tailed vole, Rocky Mountain jumping mouse, pika, masked shrew, vagrant shrew, dwarf shrew, northern water shrew, and the long-legged bat.

Small mammals of the sagebrush areas include the least chipmunk, Ord Kangaroo rat, and the rare sagebrush mouse and Merriam shrew. Grassland inhabitants are the Wyoming pocket mouse, northern grasshopper mouse, western harvest mouse, and prairie vole. Widely distributed are the northern pocket gopher, western deer mouse, white-footed mouse, meadow vole, meadow jumping mouse, and, wherever people are, the house mouse. The hispid pocket mouse may inhabit Crook County. The rare Preble shrew may inhabit parts of the study area. Bats of the study area include the little brown bat, Yuma bat, little long-eared bat, Say bat, big brown bat, hoary bat, and silver-haired bat.

The abundance and variety of small mammals in the State is important to resident mammalian predators and to resident and wintering raptorial birds.

Non-Game Wildlife - Birds

Water Birds. The many stock ponds, small reservoirs, high mountain lakes, the Powder, Tongue, North Platte, Cheyenne, and Belle Fourche Rivers, Lake DeSmet, Keyhole, Pathfinder, Alcova, Glendo, and LaPrele Reservoirs all provide acres of shoreline and riverbank nesting habitat, and miles of muddy banks and shoreline and acres of shallows for water bird feeding. Great blue herons, double-crested cormorants, gulls, grebes, coots, snipe, lesser yellowlegs, willets, avocets, terns, upland plovers, killdeer, and northern long-billed curlews all nest in the Wyoming study area. Thousands more of these species and more migrate through the area in spring and fall. The water ouzel inhabits the high mountain streams.

Birds of Prey. Except for the high mountains, the entire State of Wyoming is second only to northwestern Colorado in importance as eagle wintering habitat. In 1973, 600 bald, 9,000 golden, and 900 unidentified eagles were estimated wintering in the State. Only a small portion of the study area in Wyoming is high mountain country where few, or no, eagles winter; the rest is largely excellent eagle wintering habitat (Wrakestraw, 1972). A population estimate is one eagle for each three square miles in the area between Casper and Douglas, Wyoming (Roop, 1973). Usually, golden eagles are widespread and bald eagles more numerous along rivers. The Black Hills are an important wintering area for large numbers of bald eagles, as well as golden eagles. Abundance of prey species, mainly small mammals which do not hibernate, largely determines eagle concentration. Nesting densities of both eagle species is low. Within the study area, golden eagles nest in many areas, while only a few bald eagles nest along the North Platte River near Casper. Eagles are susceptible to electrocution while perching on powerline poles, and many are caught in open traps set for carnivorous furbearers.

American osprey are occasionally observed near Lake DeSmet. Other birds of prey inhabiting the study area include the marsh hawk, red-tailed hawk, Swainson's hawk, rough-legged hawk, sharp-shinned hawk, Kestrel, great horned owl, and short-eared owl. Less common are the

Cooper's hawk, prairie pigeon hawk, western burrowing owl, barn owl, hawk owl, western screech owl, barred owl, long-eared owl, and saw-whet owl. Occasionally observed are the ferruginous owl, peregrine falcon, prairie falcon, snowy owl, spotted owl, and boreal owl. The turkey vulture is a common summer resident.

Reptiles. Snakes of the study area of Wyoming include the prairie rattlesnake, hog-nosed snake, milk snake, bull snake, western garter snake, plains garter snake, common garter snake and blue racer. Lizards include the sand swift, scaly lizard, six-lined lizard, short-horned lizard and the many lined skink.

Amphibians. Toads of northeast Wyoming include the plains spadefoot, the Great Basin spadefoot, the Great Plains toad, and the Rocky Mountain toad. Frogs include the boreal chorus frog and the leopard frog. The tiger salamander also inhabits the area.

Endangered Wildlife

Threatened

The following species, threatened with extinction, inhabit the study area of Wyoming.

The black-footed ferret was observed once in Crook County in 1969 and once in Weston County in 1971. Exact locations were not reported by the observer. Other sightings of the black-footed ferret have been verified in the study area.

The spotted bat may occur in the study area but little is known of this rare species.

The prairie falcon frequents the area. The American peregrine falcon is commonly observed to the north in Montana and probably frequents the Wyoming study area.

Status - Undetermined

Status undetermined species which inhabit the Wyoming study area include the pine marten, common in the Big Horn Mountains; the Canada lynx and wolverine, both very rare but occasionally reported in most mountains of the study area; the northern swift fox, which may occur in the area; and the ferruginous hawk, American osprey, prairie pigeon hawk, mountain plover, northern long-billed curlew, and western burrowing owl, which are uncommon but regular inhabitants of the area.

Wyoming

Fish

The Wyoming study area encompasses a variety of fish habitats ranging from high altitude lakes and small flowing streams in the Big Horn Mountains to intermittent small tributaries on the plains. A large number of stock watering ponds and reservoirs are scattered throughout the area, many of which contain several fish species. These are usually under private ownership. However, the bulk of fish habitat in the area is found in a few larger reservoirs (Pathfinder, Alcova, Lake DeSmet, and Keyhole) and in major Missouri River tributaries (North Platte, Cheyenne, Belle Fourche, Tongue, and Powder Rivers). A large percentage of the area occupied by these stream-reservoir systems is classified as warm water habitat, although smaller tributaries and the headwater areas of streams in the mountains provide cold water environments. Pathfinder, Alcova, Lake DeSmet and upper portions of the Platte River are primarily managed as trout fisheries. Intermediate areas provide habitat for a mixed population of cold and warm water species. A short section of Sand Creek, Crook County, Wyoming, is the only "blue ribbon" trout water within the main confines of the study area. However, several streams draining into the area are prime trout waters and possess other unique attributes. The upper Clarks Fork River is free flowing, possesses scenic characteristics, and is among the very few streams with an existing high quality, natural, and self-sustaining fishery.

There are no threatened fish species occurring within the study area based on national criteria (BSFW, Resource Publication 114, 1973). However, on a State or regional basis, several species are considered rare or endangered and worthy of preservation. The rare or endangered status has generally been applied to those species whose former habitat has deteriorated resulting in a reduction in the range of the species to a few restricted areas.

The following species found in the Wyoming study area are considered to be rare or endangered:

Species	Status	Location
Shovelnose sturgeon Scaphirhynchus platorynchus	Rare	Lower Powder River
Goldeye Hiodon alosoides	Undetermined	Powder River, Clear Creek Little Missouri
Pearl dace Semotilus margarita	Rare	Niobrara River
Finescale dace Phoxinus neogacus	Rare	Niobrara River Montana Lake, Crook Co.
Sturgeon chub Hybopsis gelida	Rare	Powder and Big Horn River
Silvery minnow Hybognathus nushalis	Undetermined	Powder, Little Missouri, Belle Fourche Rivers

Fish Distribution and Species Composition

Wyoming has completed a comprehensive stream-lake survey on the area which covers most of the waters and lists present fisheries, stocking programs and some information on flows and habitat. However, the following is an area wide synopsis based principally on the larger reservoirs and major stream systems within the study area. The streams and reservoirs were characterized using three broad types of fish habitat - cold water, warm water, and the transitional waters (from cold to warm water). The delineation of these areas generally applies to the type of species typically found in a given area. Although spatial and temporal distributions could deviate significantly over a year, this delineation is based on the summer period when flows are lowest and waters are at the highest temperatures.

Cold Water Habitat. Generally, the cold water habitat located specifically in the study area is limited to mountainous and closely associated terrain. Cold water fisheries are found in the upper areas of the Tongue, Powder and Little Bighorn River drainages. These are dominated by salmonid species including the rainbow trout, brown trout and brook trout occurring either as a single species or as multi-species populations. Snake River cutthroat and mountain whitefish

also inhabit the Tongue River. Generally, in a multi-species population such as exists in the Tongue River, there is further zonation of species with the brook trout at higher elevations and an intermixture of rainbow and brown trout downstream. Because of the limited number of easily accessible salmonid waters in the areas mentioned previously, these streams receive considerable fishing pressure and often require stocking to sustain populations. Natural reproducing populations are limited, although brook, rainbow, cutthroat, and brown trout are known to reproduce naturally in the upper areas of all of these drainages. Most small tributaries in the mountains also support some cold water fish populations. Good examples are the Middle and North Fork of the Powder River above Mayoworth, Clear Creek, Crazy Woman, Upper Goose, and Piney Creeks.

The Green and Clarks Fork Rivers in Wyoming are exceptionally important trout fisheries lying outside the study area boundaries; but which are being considered as potential sources of water for coal development. These rivers have large populations of rainbow trout, brown trout, and brook trout. In addition, the Clarks Fork River and many of its tributaries support good populations of cutthroat trout.

Mixed Cold and Warm Water Species. The deeper reservoirs and associated tailwater areas downstream are generally the basic habitats supporting mixed populations. Downstream from a reservoir, trout species generally dominate the upper areas of the stream and become subdominant downstream as it grades into a warm water environment. The cold water species in these mixed fisheries in the plains area usually result from continuous stocking and other concerted management programs established subsequent to reservoir impoundment. Species introduced widely include the rainbow trout and the brown trout. Game fish in the reservoirs include walleye, sauger, northern pike, black crappie, white crappie, black bullhead, stonecat, and yellow perch. Other game species with a more restricted distribution include largemouth and smallmouth bass in Tongue River and Keyhole Reservoirs. Keyhole also

has a well established channel catfish population. A number of non-game warm water fishes are found in the reservoirs and include the widely distributed flathead chub, shorthead redhorse, and white sucker. Species with a more restricted distribution include the bigmouth buffalo, blue sucker, brook stickleback, burbot, carp, emerald shiner, fathead minnow, flathead chub, goldeye, lake chub, northern redbelly dace, pallid sturgeon, plains minnow, and river carpsucker; and the golden shiner, longnose dace, and yellow bullhead in Tongue River Reservoir.

Many of the game species listed previously, with the exception of the largemouth bass, often inhabit the mixed fisheries below existing reservoirs. However, with the exception of carp, flathead chub, goldeye, golden shiner (Tongue River), and white sucker, many of the non-game species listed above are not found in great abundance in these areas. The rock bass is another game fish found below some reservoirs.

Lake DeSmet is an important source of rainbow trout eggs for the State of Wyoming. Facilities to trap and hold fish have been developed. In 1972, approximately 4,000,000 rainbow eggs were taken. Twenty-two million walleye eggs were taken from Keyhole Reservoir in 1972.

Warm Water Species. The widely distributed game fish in the warm water environments are the channel catfish, black bullhead, sauger, and walleye. White crappie, green sunfish, smallmouth bass, and rock bass have more restricted distributions.

Smallmouth bass are limited to a small segment of the Tongue River, a number of ponds in Sheridan County and to Keyhole Reservoir on the Belle Fourche River. Largemouth bass are found throughout farm ponds and small irrigation reservoirs in Sheridan, Campbell, Johnson, Crook, and Weston Counties. The species composition of the warm water areas is dominated largely by non-game fish, some of which are also components of mixed populations both in the reservoir and the downstream areas. These species are generally widespread in distribution and tolerate a wide range of environmental conditions

and include the burbot, carp, fathead minnow, flathead chub, lake chub, longnose dace, plains minnow, river carpsucker, silvery minnow, sand shiner, plains killifish, and white sucker. Other warm water species with a more restricted distribution include the goldeye, horny head chub, sturgeon chub, suckermouth minnow, red shiner, stoneroller, quillback, plains topminnow, brassy minnow, finescale dace, and golden shiner.

Sport Fishing. A large segment of the fishing pressure in the area occurs on larger reservoirs and associated tailwaters. The attraction of fair to good mixed fisheries, good public access and the opportunity to combine fishing with other types of outdoor recreation, such as boating and picnicking account for this use, along with a shortage of nearby trout streams. Fishermen often travel to the mountain and foothill streams to the west. Lowland reservoirs account for up to three-fourths of the fishing pressure in the Wyoming portion of the study area, with Keyhole Reservoir, Lake DeSmet, and North Platte River impoundments the centers of use. Much of the pressure on the North Platte Reservoir is by nonresidents. Along with trout, where available, walleye and channel catfish are the most sought after fish. However, many other warm water species contribute to the creel. The purely trout waters within the study area are a number of mountain lakes and small streams. Good use is made of these waters where access is reasonably available, but this use does not constitute a large segment of total fishing pressure in the area.

Bird Checklist for Montana - Bowdoin National Wildlife Refuge

Season and Abundance Codes

a - abundant	S - March-May
c - common	S - June-August
u - uncommon	F - September-November
o - occasional	W - December-February
r - rare	

	S	S	F	W
Common nighthawk	c	c	c	
Ruby-throated hummingbird		o		
Belted kingfisher	u	o		
Yellow-shafted flicker	c	c		
Red-shafted flicker			c	u
Red-headed woodpecker		u	u	
Yellow-bellied sapsucker	o	o	o	
Hairy woodpecker	c			
Downy woodpecker	c	u	u	c
Eastern kingbird	a	a	a	
Western kingbird	u	u	u	
Say's phoebe	c	o	c	
Trails flycatcher	c	c	o	
Least flycatcher	o	o		
Western flycatcher	o	r	r	
Western wood pewee	u	u		
Horned lark	a	a	a	a
Tree swallow	u	c		
Bank swallow	a	a	a	
Rough-winged swallow	a	a	a	
Barn swallow	a	a	a	
Cliff swallow	c	u		
Purple martin	u			
Black-billed magpie	a	a	a	a
Common crow	c	r	c	
Black-capped chickadee	c		c	c
Mountain chickadee				u
Red-breasted nuthatch	u		u	
House wren	u	c	c	
Long-billed marsh wren	a	a	a	
Rock wren	u	u	u	
Catbird	c	o		
Brown thrasher	a	a	a	
Robin	a	a	a	
Wood thrush	r	r		
Hermit thrush	u	u	u	
Swainson's thrush	o		o	

	S	S	F	W
Mountain bluebird	c			
Townsend's solitaire	r			u
Water pipit	o	o		
Sprague's pipit	c	c	u	
Bohemian waxwing	c		c	c
Cedar waxwing	c	c	o	o
Northern shrike			c	
Loggerhead shrike	o	o	o	
Starling	u	u	a	u
Red-eyed vireo	o	o	o	
Warbling vireo	u			
Orange-crowned warbler	u	u	u	
Yellow warbler	a	a	a	
Myrtle warbler	c		c	
Audubon's warbler	c		c	
Blackpoll warbler	o			
Ovenbird	o	o		
Northern waterthrush	o	o	o	
Mourning warbler	u	u	u	
McGillivray's warbler	o	o	o	
Yellowthroat		c		
Yellow-breasted chat	u	u		
Wilson's warbler			o	
American redstart	o	o		
House sparrow	a	a	a	a
Bobolink	u	u		
Western meadowlark	a	a	a	
Yellow-headed blackbird	a	a	a	
Red-winged blackbird	a	a	a	
Baltimore oriole	u		u	
Bullock's oriole	u	u	u	
Brewer's blackbird	a	a	a	
Common grackle	c	c		
Brown-headed cowbird	c	c		
Western tanager	o			
Rose-breasted grosbeak	r	r	r	
Black-headed grosbeak		u	u	

Bird Checklist for Montana - Continued

	S	S	F	W
Blue grosbeak	o	o		
Evening grosbeak				u
Pine grosbeak	o		o	
Lazuli bunting	u	u		
Hoary redpoll	c		c	c
Common redpoll	u			
Pine siskin	u	u	u	
American goldfinch	a	a	a	
Rufous-sided towhee			u	
Lark bunting	a	a	c	
Savannah sparrow	c	a	c	
Grasshopper sparrow	c	c		
Baird's sparrow	u	o	o	
LeConte's sparrow	u			
Vesper sparrow	u	u	o	
Lark sparrow		u	u	
Slate-colored junco	c		c	u
Oregon junco	c		c	c
Tree sparrow	c		c	u
Chipping sparrow	o	o	o	
Clay-colored sparrow	c	c	u	
Brewer's sparrow	c	c	u	
Harris' sparrow	c		c	
White-crowned sparrow	a		a	
White-throated sparrow	o	o	o	
Fox sparrow	u	u	u	
Lincoln's sparrow	c	c	c	
Song sparrow	c	c	c	
McCown's longspur	u	r		
Chestnut-collared longspur	a	a	a	
Snow bunting				c

Partial Small Mammal Checklist[1/] for NGPRP Area, South Dakota
(Counties: Butte, Corson, Dewey, Harding
Meade, Perkins, Ziebach)

Long-eared bat
Small-footed bat
Little brown bat
Long-legged bat
Silver-haired bat
Big brown bat
Hoary bat
Townsend's big-eared bat
Least chipmunk
Thirteen-lined ground squirrel
Northern pocket gopher
Olive-backed pocket mouse
Hispid pocket mouse
Ord's kangaroo rat
Western harvest mouse
Plains harvest mouse
White-footed mouse
Deer mouse
Northern grasshopper mouse
Bushy-tailed wood rat
Prairie vole
Meadow vole
House mouse
Meadow jumping mouse

(The following are suspected to be present):

Keen's bat
Red bat
Hayden shrew
Merriam shrew
Least weasel
Richardsons' ground squirrel
Norway rat
Pallid meadow mouse

1/ Anderson, K. W. and J. K. Jones, Jr., 1971. University of Kansas Publ., Museum of Natural History, Vol. 19, pp. 361-393, 8 figs.

Bird Checklist for NGPRP Area, South Dakota
(Counties: Butte, Corson, Dewey, Harding, Meade, Perkins, Ziebach)

*Key:

R - Resident	a - abundant
M - Migrant	c - common
W - Winter visitor	fc - fairly common
S - Summer visitor	u - uncommon
	r - rare

Common Name	Occurrence*	Common Name	Occurrence*
Common loon	Mu	Evening grosbeak	Wfc
Horned grebe	Su, Mc	Gray-crowned rosy finch	Wfc
Eared grebe	Mc	Common redpoll	Wfc
Western grebe	Mu	Hoary redpoll	Wr
Pied-billed grebe	Sc	Pine siskin	Wfc
Double-crested cormorant	Sfc, Mu	American goldfinch	Sfc, Wu
Great blue heron	Sfc	Cassin's finch	Wu
Green heron	Su	Purple finch	Wfc
Snowy egret	Mu	Red crossbill	Ru
Common egret	Su	Rufous-sided towhee	Sc
Black-crowned night heron	Su	Lark bunting	Sa
American bittern	Sfc	Savannah sparrow	Sfc
Least bittern	Sr	Grasshopper sparrow	Sc
White pelican	Su, Mu	Baird's sparrow	Sr
Trumpeter swan	Sr	Vesper sparrow	Sc
Whistling swan	Mu	Lark sparrow	Sc
Canada goose	Mfc, Su	Brewer's sparrow	Su
White-fronted goose	Mu	Field sparrow	Sfc
Snow goose	Mu	Fox sparrow	Mu
Blue goose	Mr	Swamp sparrow	Mu
Mallard	Sa, Wu	White-winged junco	Ru
Gadwall	Sa	Slate-colored junco	Mc
Pintail	Ma, Sfc	Oregon junco	Wfc
Green-winged teal	Mc, Su	Tree sparrow	Wc
Blue-winged teal	Sa	Chipping sparrow	Sfc
Cinnamon teal	Mu	Clay-colored sparrow	Mfc
American widgeon	Sc	Harris' sparrow	Mu
Shoveler	Sc	White-crowned sparrow	Mfc
Redhead	Mfc	White-throated sparrow	Mu
Ring-necked duck	Mfc	Lincoln's sparrow	Mfc
Canvasback	Mu	Song sparrow	Mfc
Lesser scaup	Mc	McCown's longspur	Mu
Common goldeneye	Mc	Lapland longspur	Wfc
Bufflehead	Mc	Chestnut-collared longspur	Sc
Dickcissel	Sfc	Snow bunting	Wu

Bird Checklist for South Dakota - Continued

Common Name	Occurrence*		
Ruddy duck	Mc	White-rumped sandpiper	Mfc
Woodduck	Sfc	Willet	Su, Mfc
Greater scaup	Mr	Ruddy turnstone	Mu
Red-breasted merganser	Mfc	Greater yellowlegs	Mfc
Hooded merganser	Mfc	Lesser yellowlegs	Mc
Common merganser	Mfc	Pectoral sandpiper	Mu
Turkey vulture	Sc	Baird's sandpiper	Mc
Goshawk	Wu	Least sandpiper	Mc
Sharp-shinned hawk	Su	Long-billed dowitcher	Mfc
Cooper's hawk	Su	Dowitcher	Mfc
Red-tailed hawk	Rc	Stilted sandpiper	Mfc
Swainson's hawk	Sc	Semipalmated sandpiper	Mfc
Rough-legged hawk	Wfc	Western sandpiper	Mr
Ferruginous hawk	Rfc	Marbled godwit	Su
Broad-winged hawk	Mu	Hudsonian godwit	Mu
Harlan's hawk	Mu	Northern phalarope	Mu
Golden eagle	Rfc	Sanderling	Mu
Bald eagle	Wu	American avocet	Sfc
Marsh hawk	Sc	Wilson's phalarope	Sc
Osprey	Mu	Ring-billed gull	Mfc
Prairie falcon	Rc	Franklin's gull	Mfc
Peregrine falcon	Mr	Forester's tern	Mfc
Pigeon hawk	Ru	Common tern	Mu
Sparrow hawk	Sc	Black tern	Su, Mc
Greater prairie chicken	Rr	Least tern	Su
Sharp-tailed grouse	Rc	Herring gull	Mfc
Sage grouse	Ru	California gull	Mr
Ring-necked pheasant	Rc	Rock dove	Ru
Chukar	Rr	Mourning dove	Sa
Gray partridge	Ru	Barn owl	Su
Merriam's turkey	Ru	Screech owl	Su
Rio Grande turkey	Ru	Great horned owl	Rfc
Whooping crane	Mr	Snowy owl	Wu
Sandhill crane	Mc	Burrowing owl	Sfc
Virginia rail	Su	Short-eared owl	Sfc, Wu
Sora	Su	Saw-whet owl	Sr
American coot	Sc	Long-eared owl	Su
Semipalmated plover	Mc	Yellow-billed cuckoo	Su
Killdeer	Sa	Black-billed cuckoo	Su
Common snipe	Mfc, Sr	Common nighthawk	Sc
Long-billed curlew	Sfc	White-throated swift	Su
Upland plover	Sc	Poor-will	Su
Golden plover	Mu	Ruby-throated hummingbird	Mu
Black-bellied plover	Mu	Belted kingfisher	Sfc, Wu
Piping plover	Mu	Yellow-bellied sapsucker	Mu
Spotted sandpiper	Mfc, Sfc	Yellow-shafted flicker	Rc
Solitary sandpiper	Mu	Red-shafted flicker	Rc

Bird Checklist for South Dakota - Continued

Common Name	Occurrence*
Red-headed woodpecker	Sc
Hairy woodpecker	Rc
Downy woodpecker	Rc
Lewis's woodpecker	Ru
Eastern kingbird	Sc
Western kingbird	Sc
Say's phoebe	Sfc
Traill's flycatcher	Su
Least flycatcher	Su
Great-crested flycatcher	Su
Olive-sided flycatcher	Mu
Eastern phoebe	Su
Western wood pewee	Su
Horned lark	Ra
Violet-green swallow	Su
Tree swallow	Mu
Bank swallow	Su
Rough-winged swallow	Sc
Barn swallow	Sc
Cliff swallow	Sa
Purple martin	Su
Blue jay	Rfc
Black-billed magpie	Rfc
Common crow	Wu, Sfc
Pinon jay	Ru
Black-capped chickadee	Rfc
White-breasted nuthatch	Rfc
Red-breasted nuthatch	Wfc
Brown creeper	Wu
House wren	Sc
Long-billed marsh wren	Su
Canon wren	Su
Rock wren	Sfc
Mockingbird	Rr
Catbird	Sfc
Brown thrasher	Sc
Sage thrasher	Su
Robin	Sc, Wu
Swainson's thrush	Mc
Gray-cheeked thrush	Mc
Veery	Mu
Mountain bluebird	Su, Mfc
Townsend's solitaire	Ru
Hermit thrush	Mu
Eastern bluebird	Su
Ruddy-crowned kinglet	Mfc
Golden-crowned kniglet	Mu
Water pipit	Mfc
Sprague's pipit	Su, Mu
Bohemian waxwing	Wu
Cedar waxwing	Rc
Northern shrike	Wfc
Loggerhead shrike	Sc
Starling	Rc
Red-eyed vireo	Sfc
Warbling vireo	Sfc
Solitary vireo	Su
Bell's vireo	Su
Philadelphia vireo	Mu
Bay-breasted warbler	Mu
Magnolia warbler	Mu
Chestnut-sided warbler	Mu
Black-throated green warbler	Mu
Palm warbler	Mu
Tennessee warbler	Mu
Black-and-White warbler	Mu
Orange-crowned warbler	Mc
Yellow warbler	Sc
Myrtle warbler	Ma
Audubon's warbler	Su
Blackpoll warbler	Mfc
Ov' bird	Su
No..hern waterthrush	Mu
Yellowthroat	Sc
Yellow-breasted chat	Sfc
Wilson's warbler	Mfc
American redstart	Sfc
House sparrow	Ra
Bobolink	Sfc
Western meadowlark	Sa
Yellow-headed blackbird	Sfc
Red-winged blackbird	Sa
Rusty blackbird	Mu
Orchard oriole	Sfc
Baltimore oriole	Sfc
Bullock's oriole	Sc
Brewer's blackbird	Sfc
Common grackle	Sc
Brown-headed cowbird	Sc
Western tanager	Su
Pine grosbeak	Wu
Rose-breasted grosbeak	Su
Black-headed grosbeak	Sfc
Blue grosbeak	Su
Indigo bunting	Su
Luzuli bunting	Su

BIBLIOGRAPHY

Anderson, K. W. and J. K. Jones, Jr.

1971. Mammals of Northwestern South Dakota. University of Kansas Publ., Museum of Natural History. Vol. 19, pp. 361-393; illustrated.

Bailey, V.

1926. A Biological Survey of North Dakota. USGPO, Washington, D. C. 226 pp.

Bureau of Sport Fisheries and Wildlife.

1972. Relative Indices of Predator Abundance in Western United States. 91 pp.

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1973. Threatened Wildlife of the United States. Resource Publication 114. 289 pp.

Knapp, Steve.

1973. Mule Deer, Distribution and Range Use. Montana Dept. of Fish and Game. 6pp plus 5 tables.

Kufeld, Roland C.

1973. Food Eaten by the Rocky Mountain Elk. Journal of Range Management. Vol. 26, pp. 106-113.

Missouri Basin Inter-Agency Committee.

1971. Missouri River Basin Comprehensive Framework Study, 1969. Vols. 1-7. U.S. Govt. Printing Office, Washington, D. C.

Mussehl, T. W. and F. W. Howell (editors).

1971. Game Management in Montana. Montana Dept. of Fish and Game. 238 pp.

Roby, Garvice.

1972. Deer Feeding Habit Determinations. Wyoming Game and Fish Commission. 8 pp.

Roop, Larry.

1973. Eagles Today. Wyoming Wildlife, pp. 14-17.

Sundstrom, Charles, G. W. Hepworth; and K. L. Diem.

1973. Abundance, Distribution, and Food Habits of the Pronghorn. Wyoming Game and Fish Commission. Bul. No. 12. 61 pp.

Wrakestraw, G. F.

1972. 1972 Wyoming Bald and Golden Eagle Survey. Wyoming Game and Fish Commission. 7 pp.

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APPENDIX C
FISH AND WILDLIFE HABITAT MAPS

The following maps, at a scale of 1:1,000,000 graphically portray information to support the narrative:

1. Lands managed for fish and wildlife by federal, state, and city agencies.
2. Deer habitat quality and key areas.
3. Elk habitat quality and key areas.
4. Antelope habitat quality and key areas.
5. Bighorn sheep habitat quality and key areas.
6. Black bear habitat quality and key area.
7. Coyote habitat quality and key area.
   Black-footed ferret observations
8. Ruffed grouse habitat quality and key areas.
   Chukar partridge habitat quality
9. Hungarian partridge habitat quality and key areas.
   Blue grouse habitat quality
10. Sharp-tailed grouse habitat quality and key areas.
11. Sage grouse habitat quality and key areas.
    Prairie chicken habitat quality
12. Ring-necked pheasant habitat quality and key areas.
13. Turkey habitat quality and key areas.
14. Geese habitat quality and key areas.
15. Duck habitat quality and key areas.
16. Golden eagle habitat quality and key areas.
17. Whistling swan migration distribution and key areas.
18. Sandhill crane migration distribution and key areas.
19. Fish habitat--cold water, mixed, and warm water species.
20. Paddlefish--known and probable distribution.

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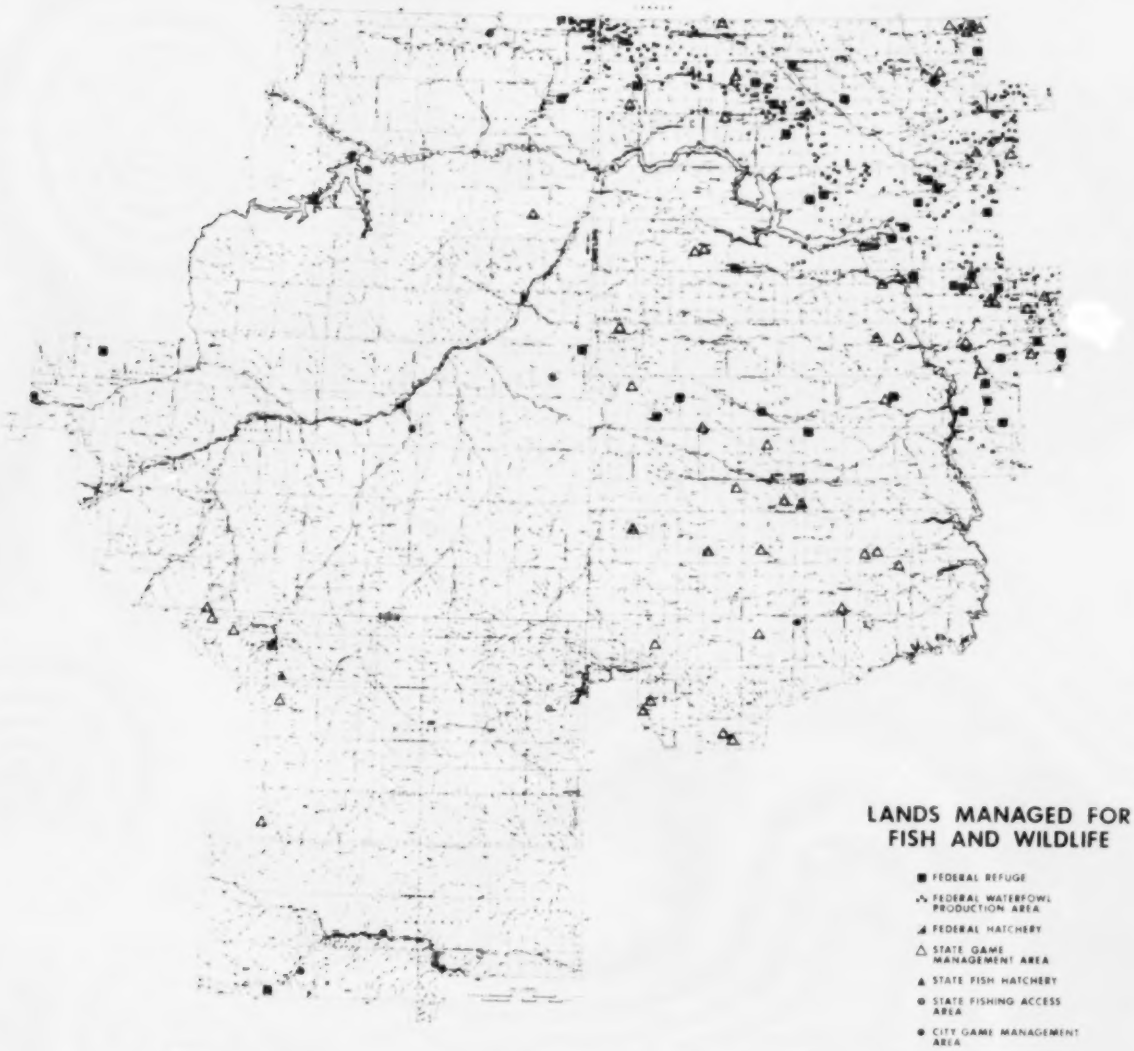

Figure 1. Lands managed for fish and wildlife by federal, state, and city agencies.

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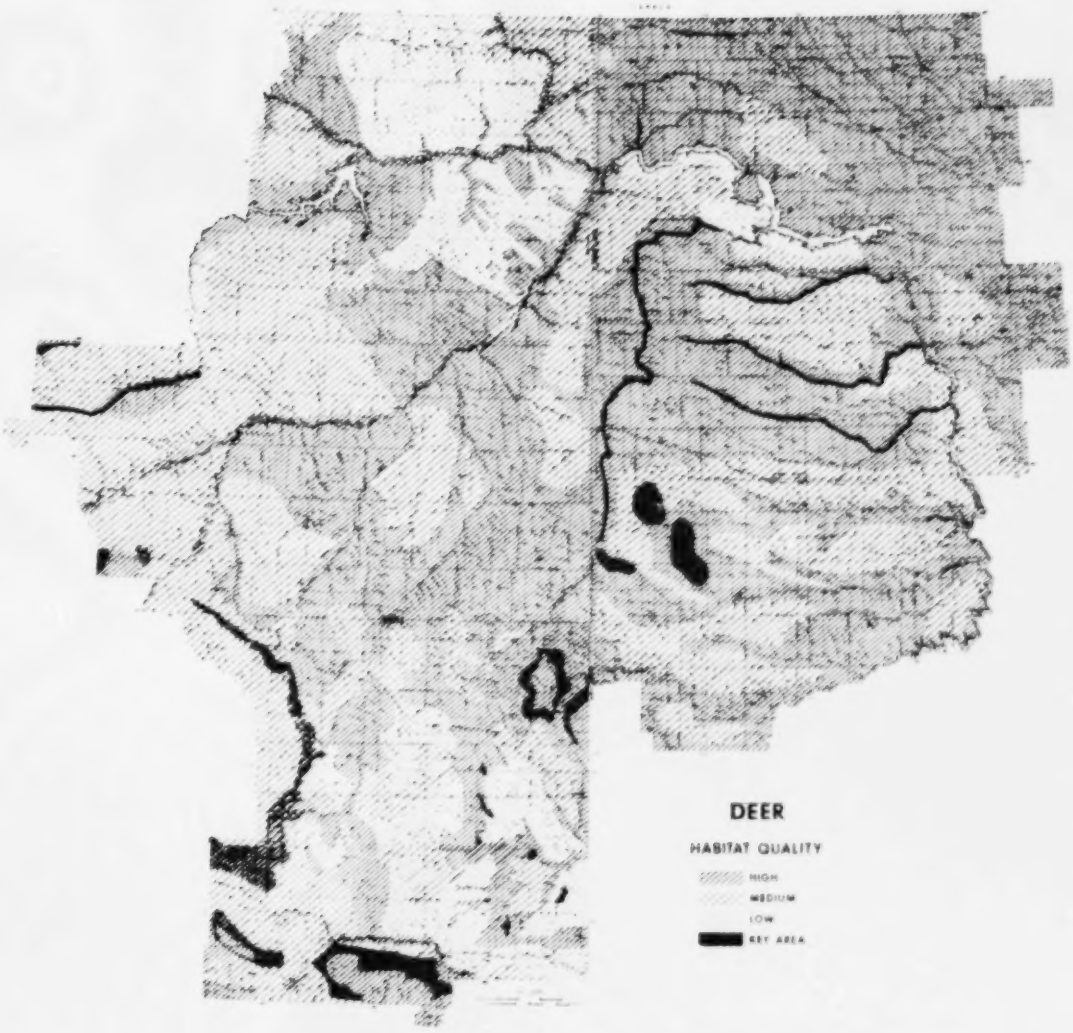

Figure 2. Deer habitat quality and key areas.

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Figure 3. Elk habitat quality and key areas.

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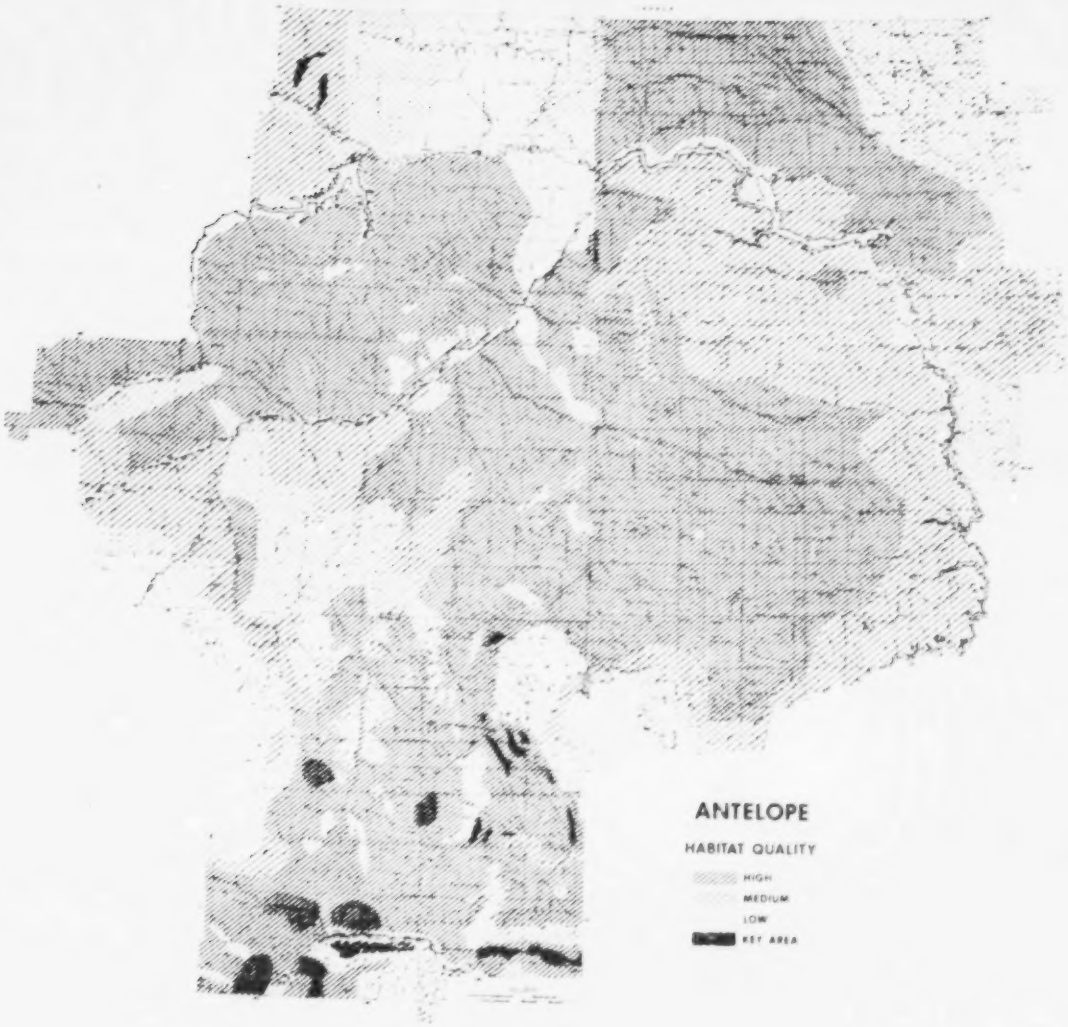

Figure 4. Antelope habitat quality and key areas.

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Figure 5. Bighorn sheep habitat quality and key areas.

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Figure 6. Black bear habitat quality and key areas.

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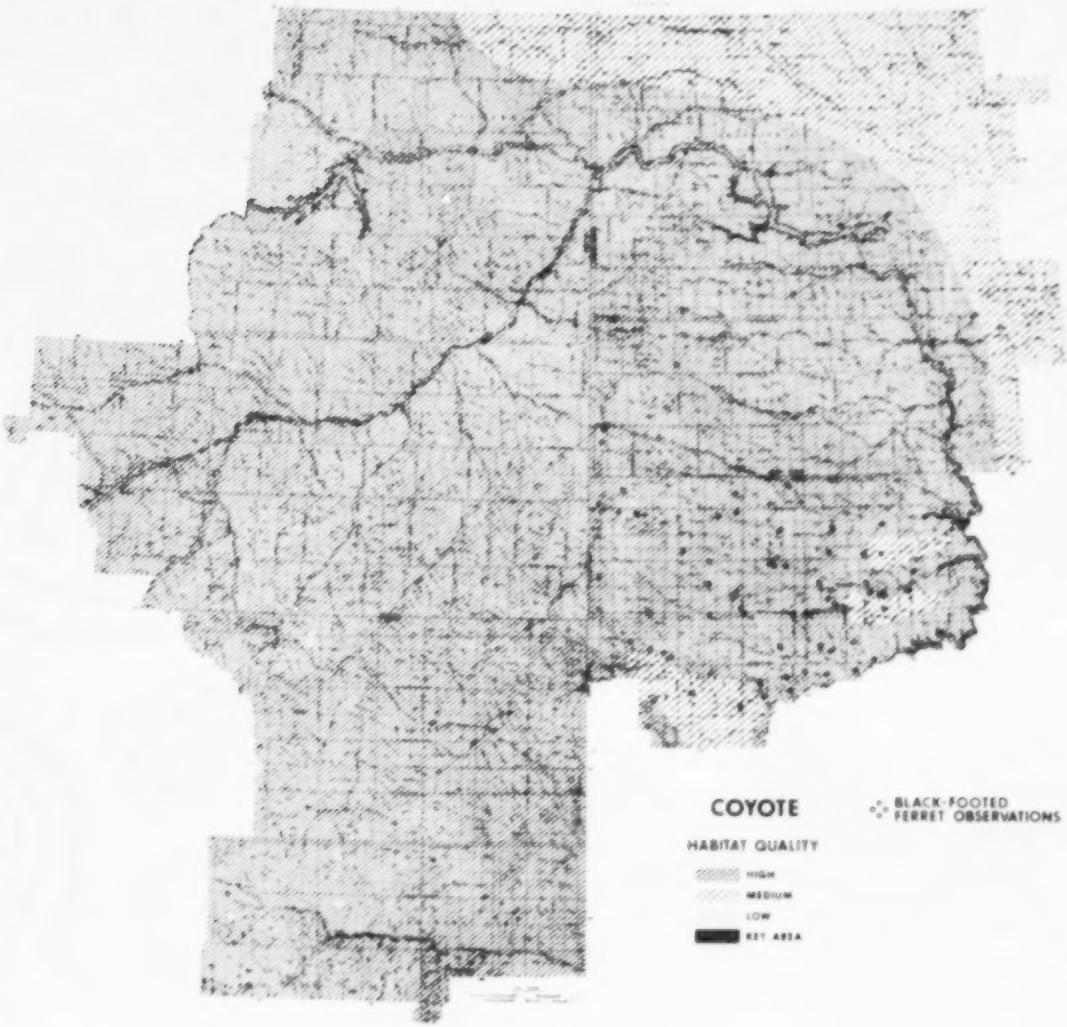

Figure 7. Coyote habitat quality and key areas. Black-footed ferret observations.

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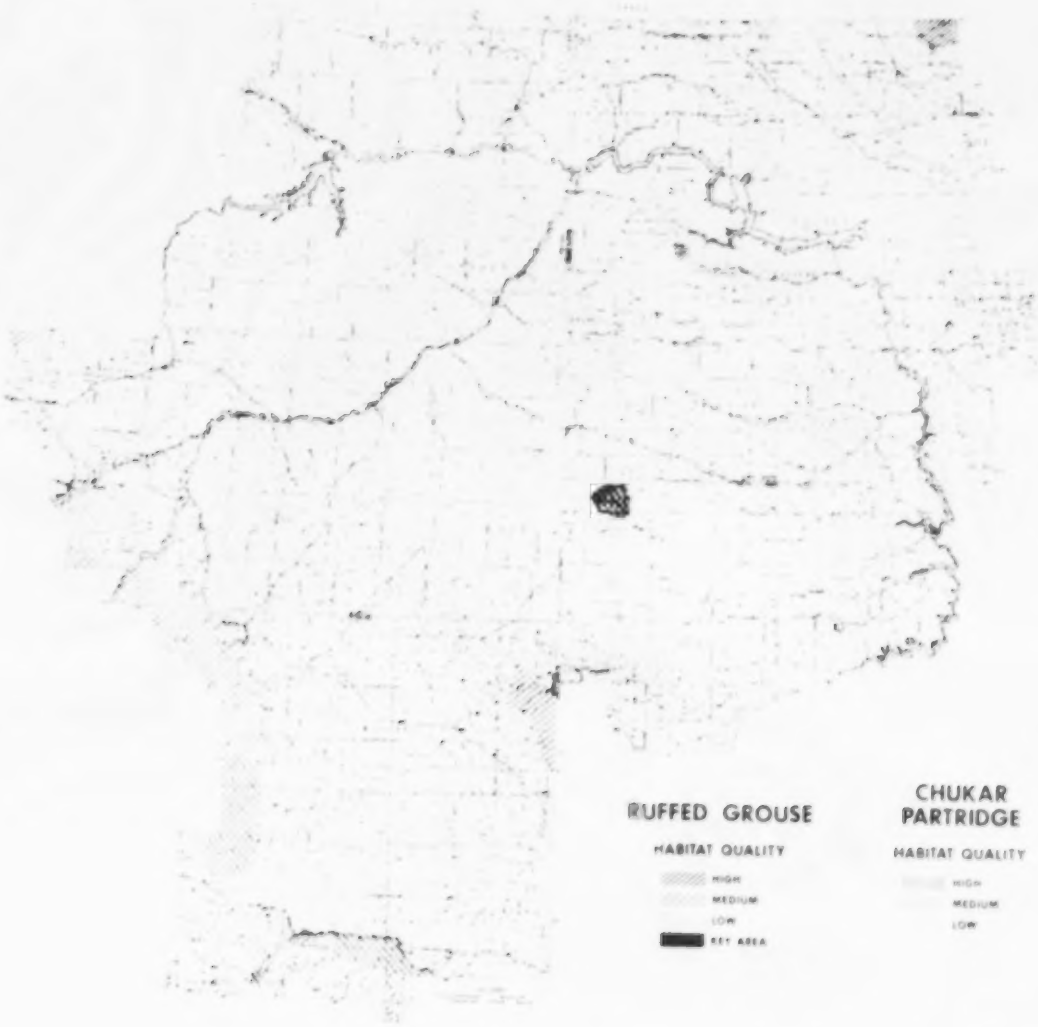

Figure 8. Ruffed grouse habitat quality and key areas. Chukar partridge habitat quality.

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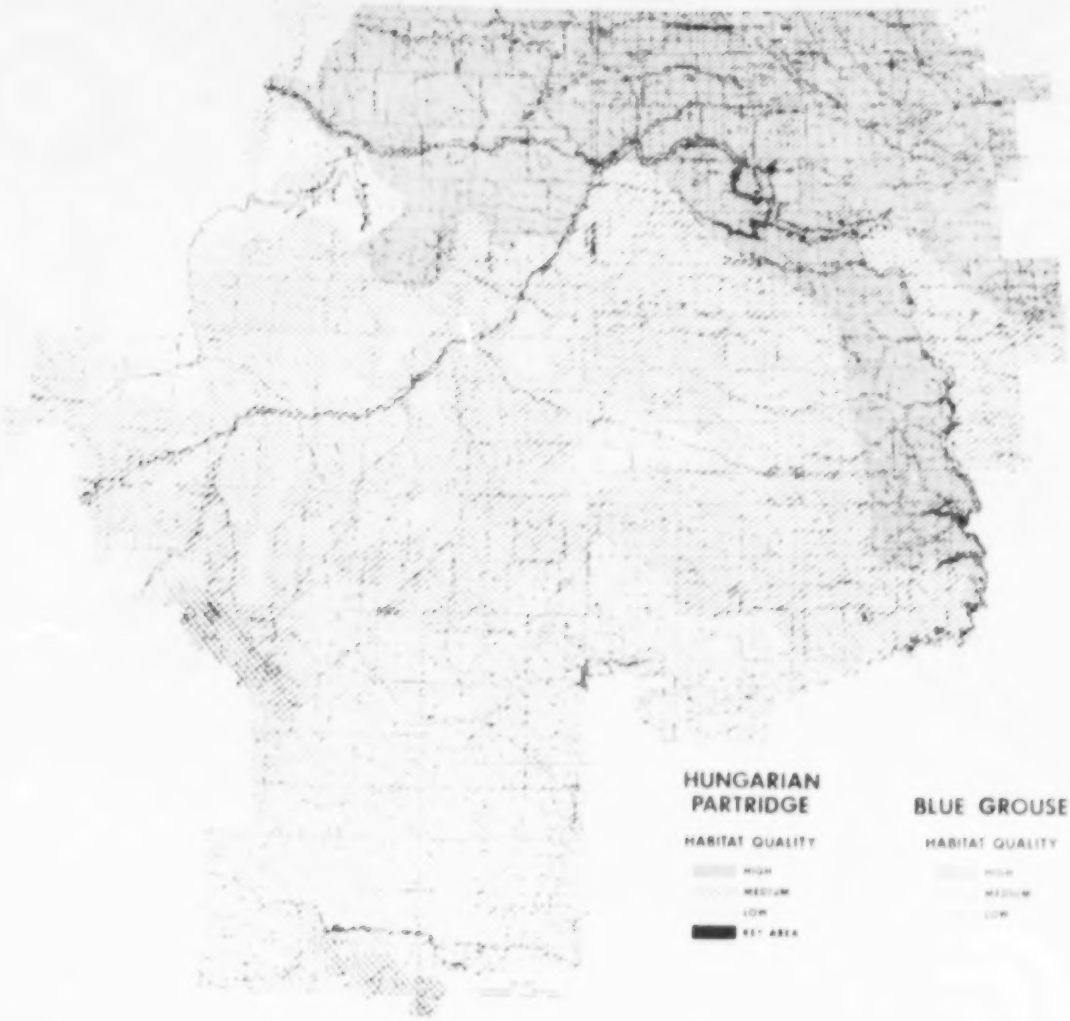

Figure 9. Hungarian partridge habitat quality and key areas. Blue grouse habitat quality.

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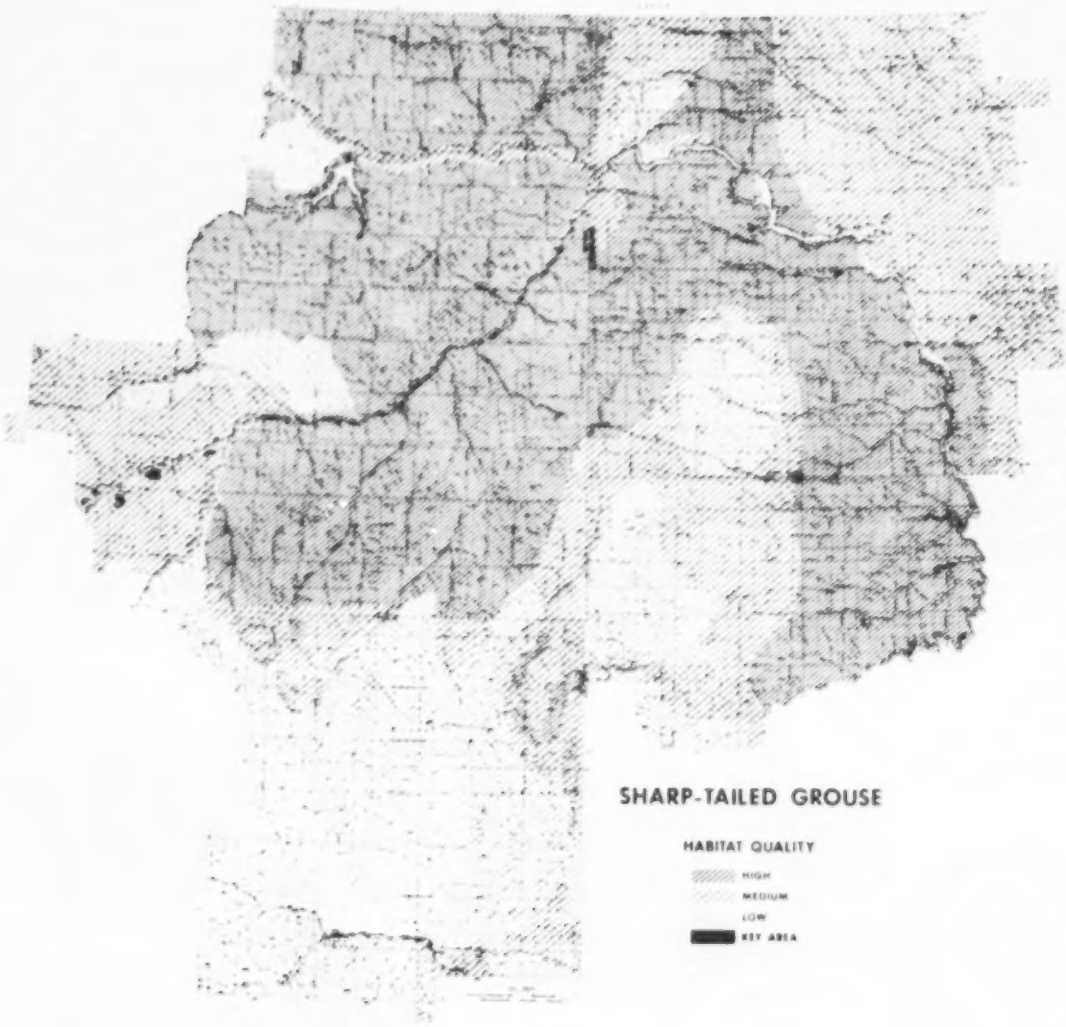

Figure 10. Sharp-tailed grouse habitat quality and key areas.

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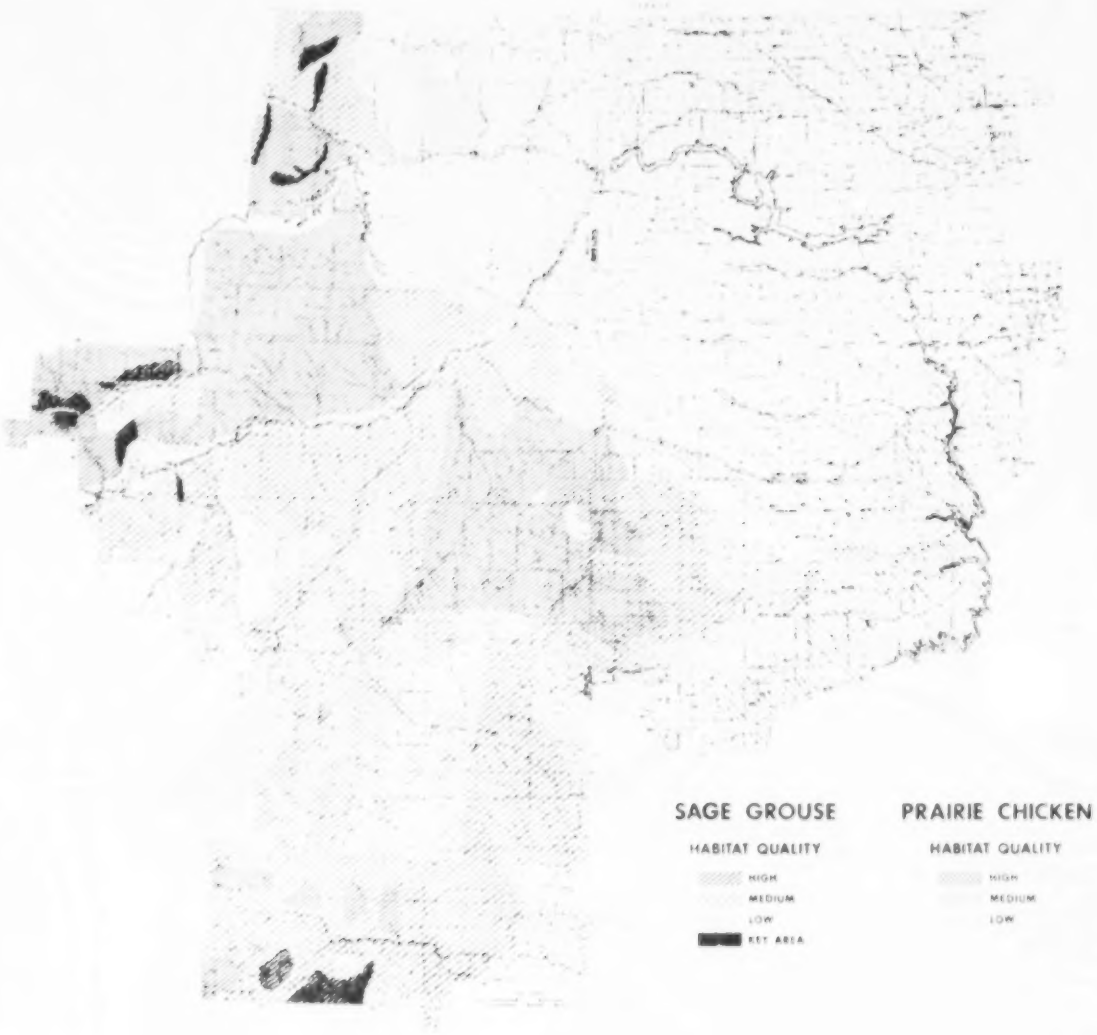

Figure 11. Sage grouse habitat quality and key areas.
Prairie chicken habitat quality.

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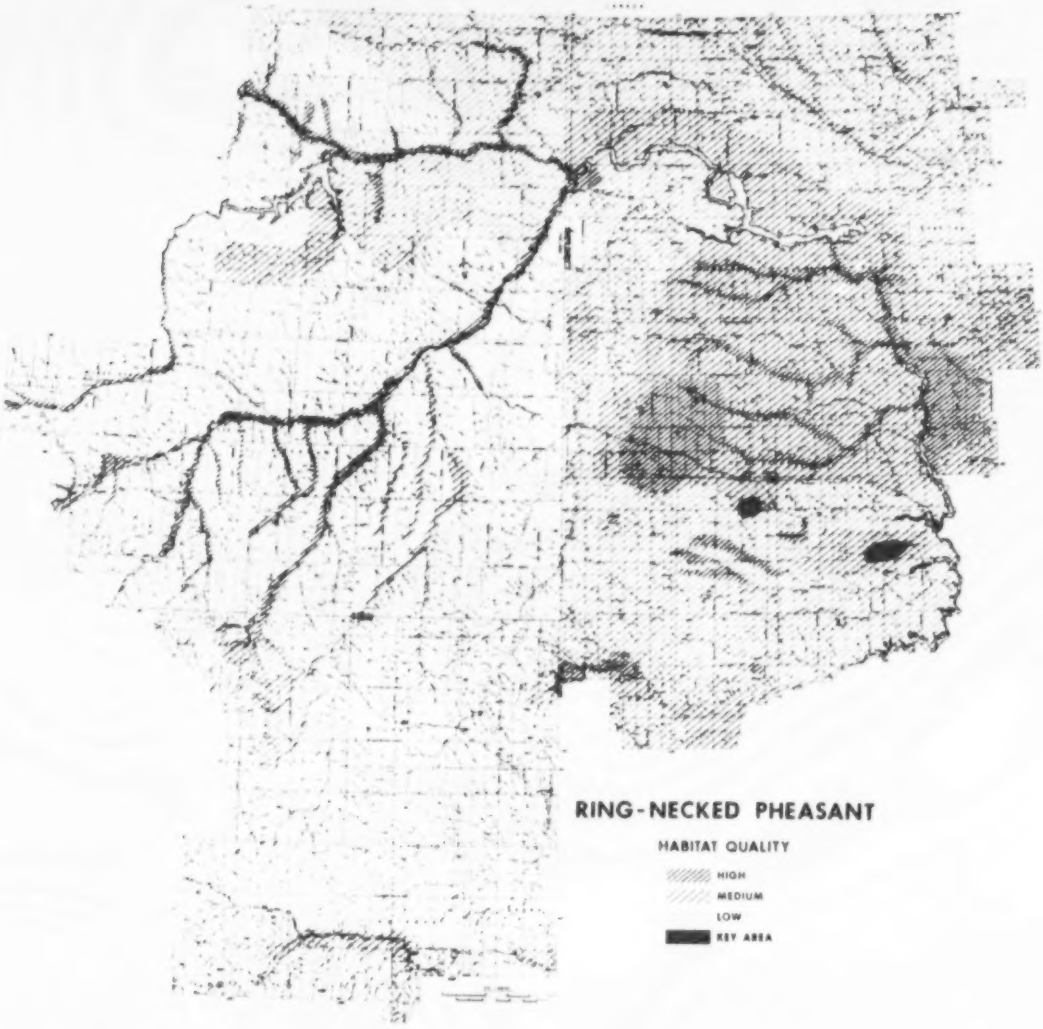

Figure 12. Ring-necked pheasant habitat quality and key areas.

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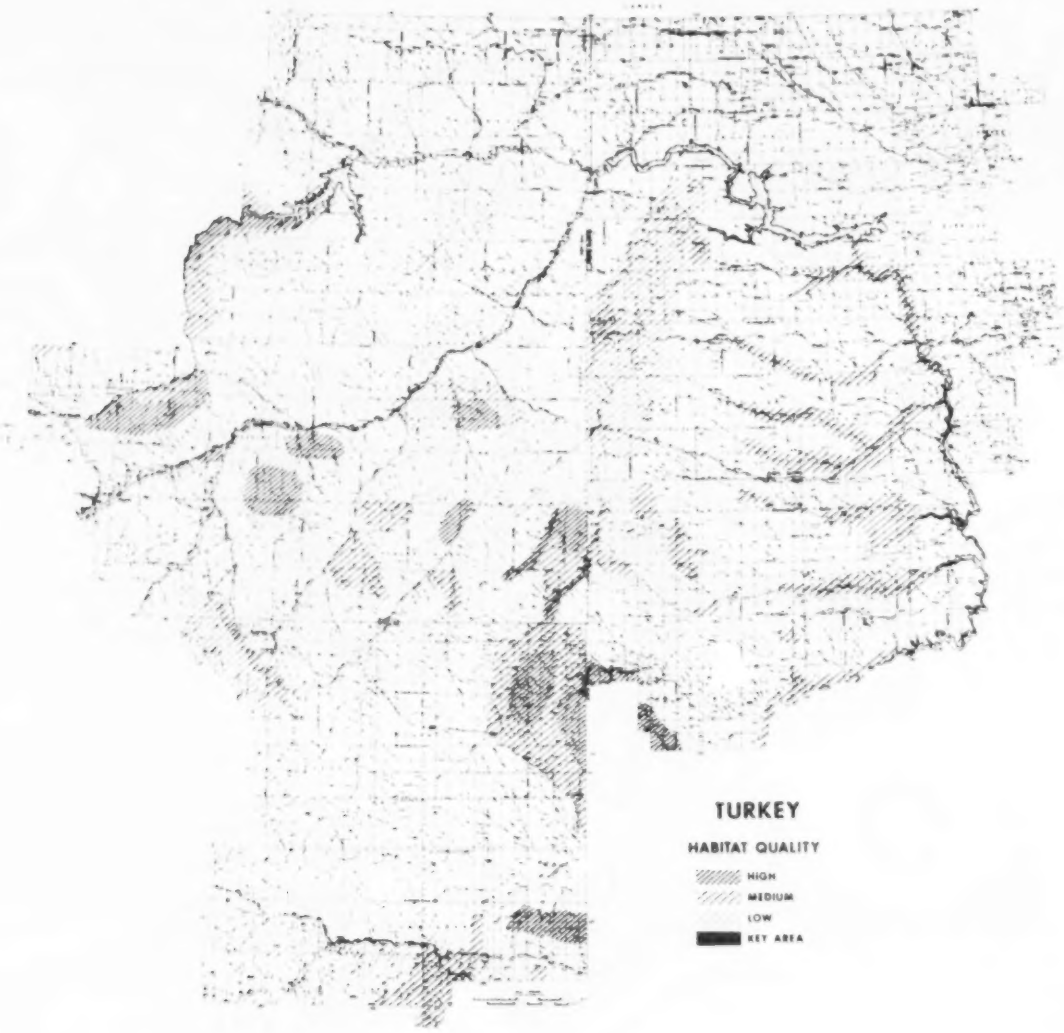

Figure 13. Turkey habitat quality and key areas.

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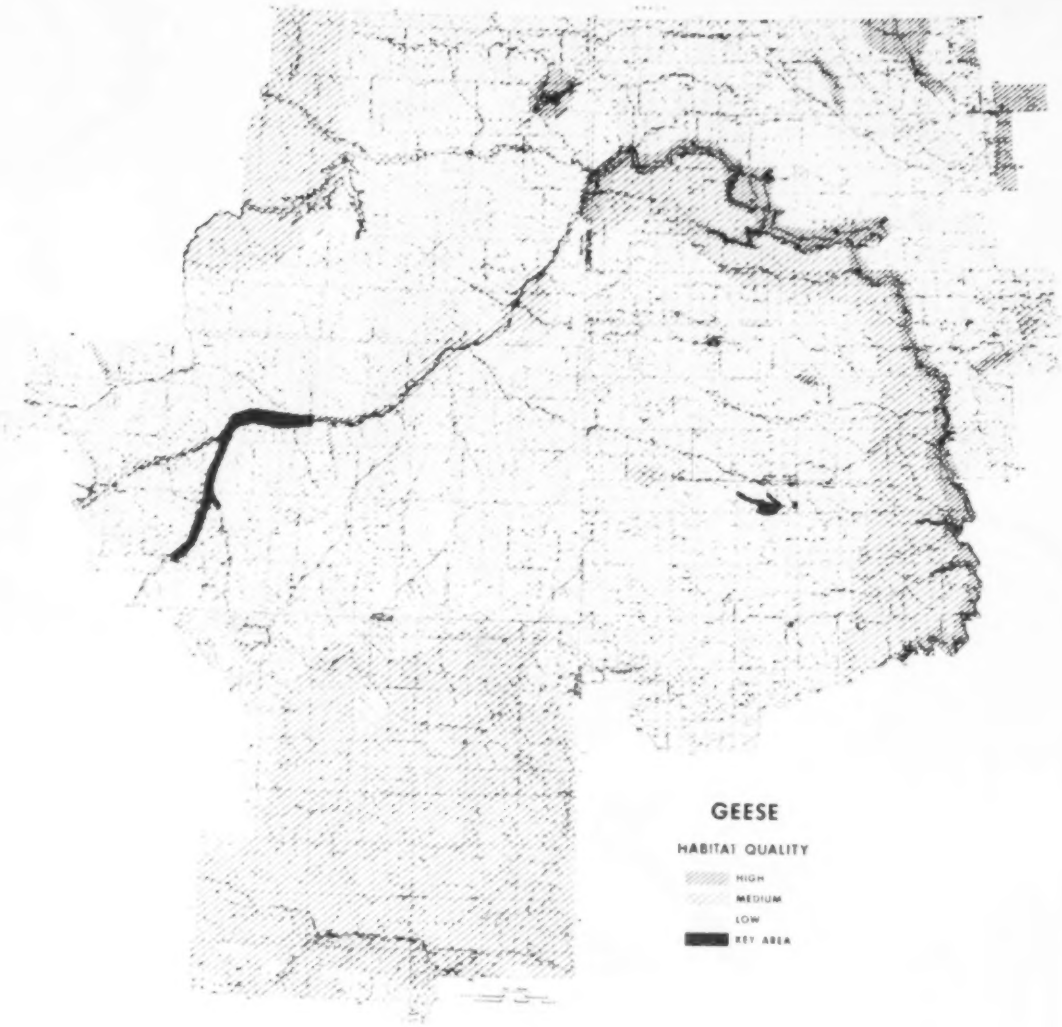

Figure 14. Geese habitat quality and key areas.

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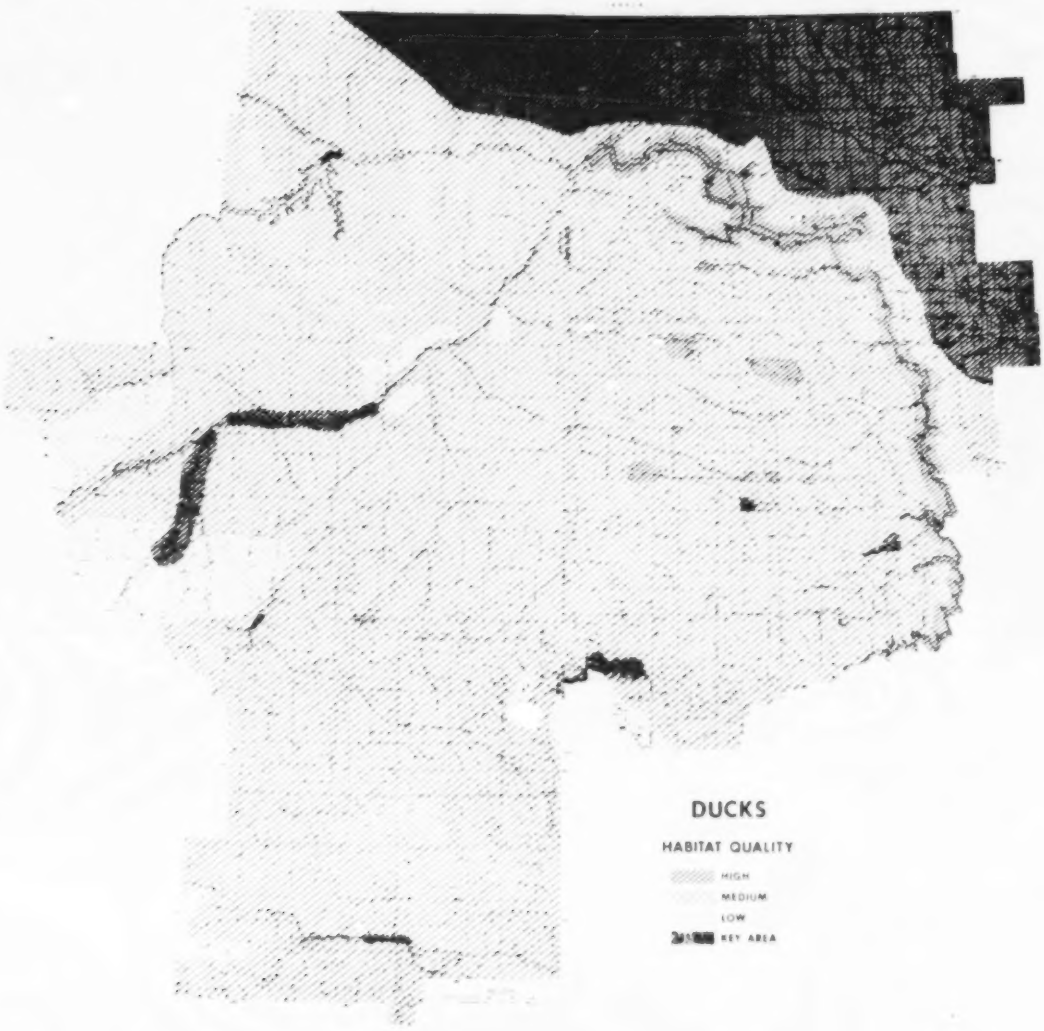

Figure 15. Duck habitat quality and key areas.

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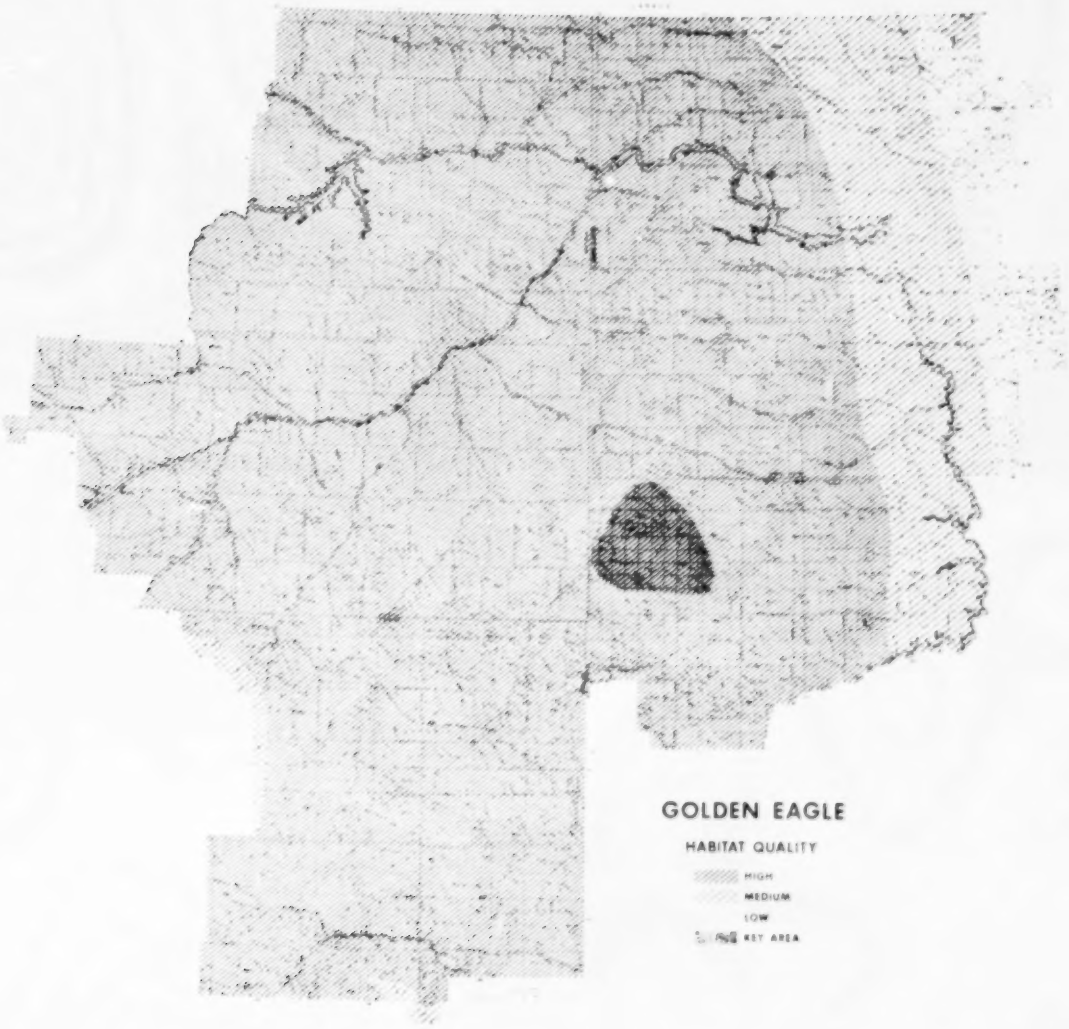

Figure 16. Golden eagle habitat quality and key areas.

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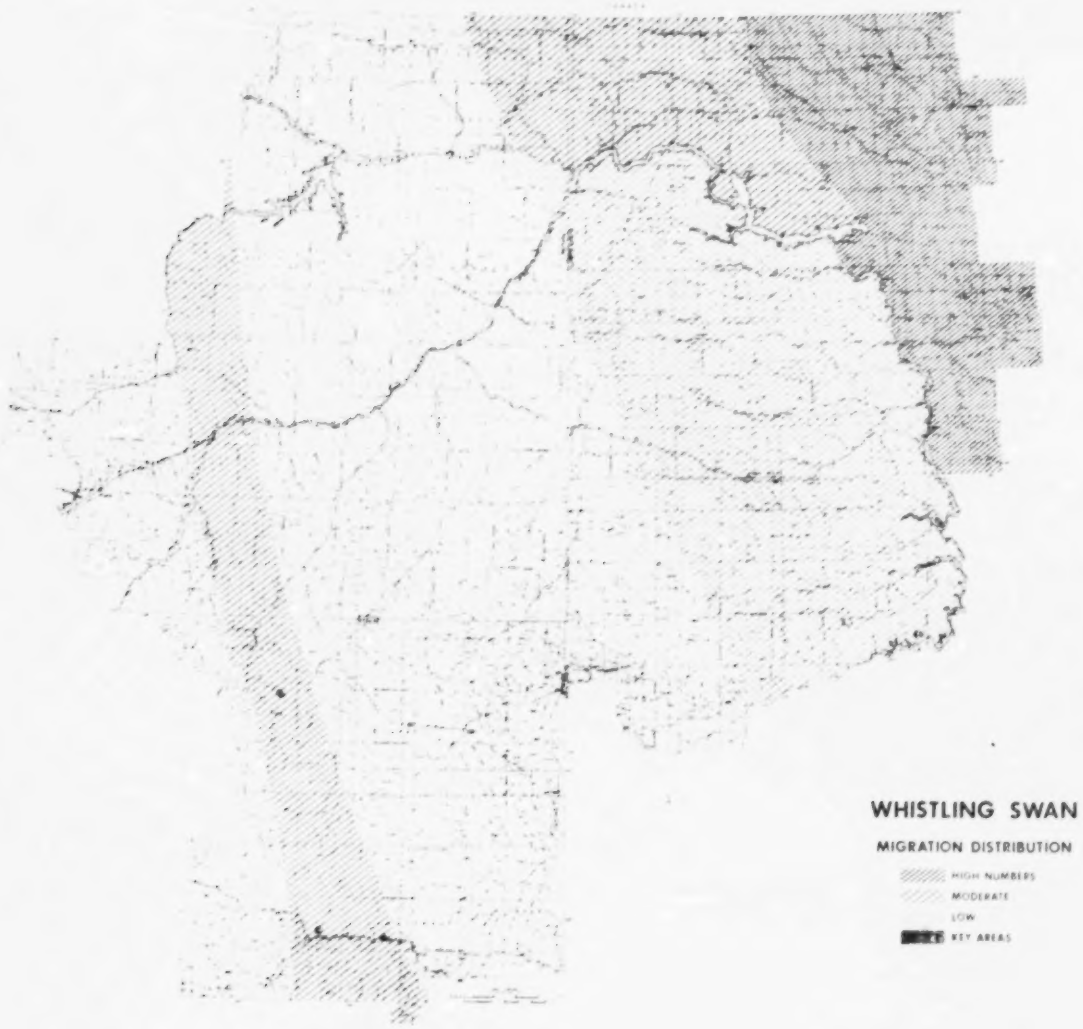

Figure 17. Whistling swan migration distribution and key areas.

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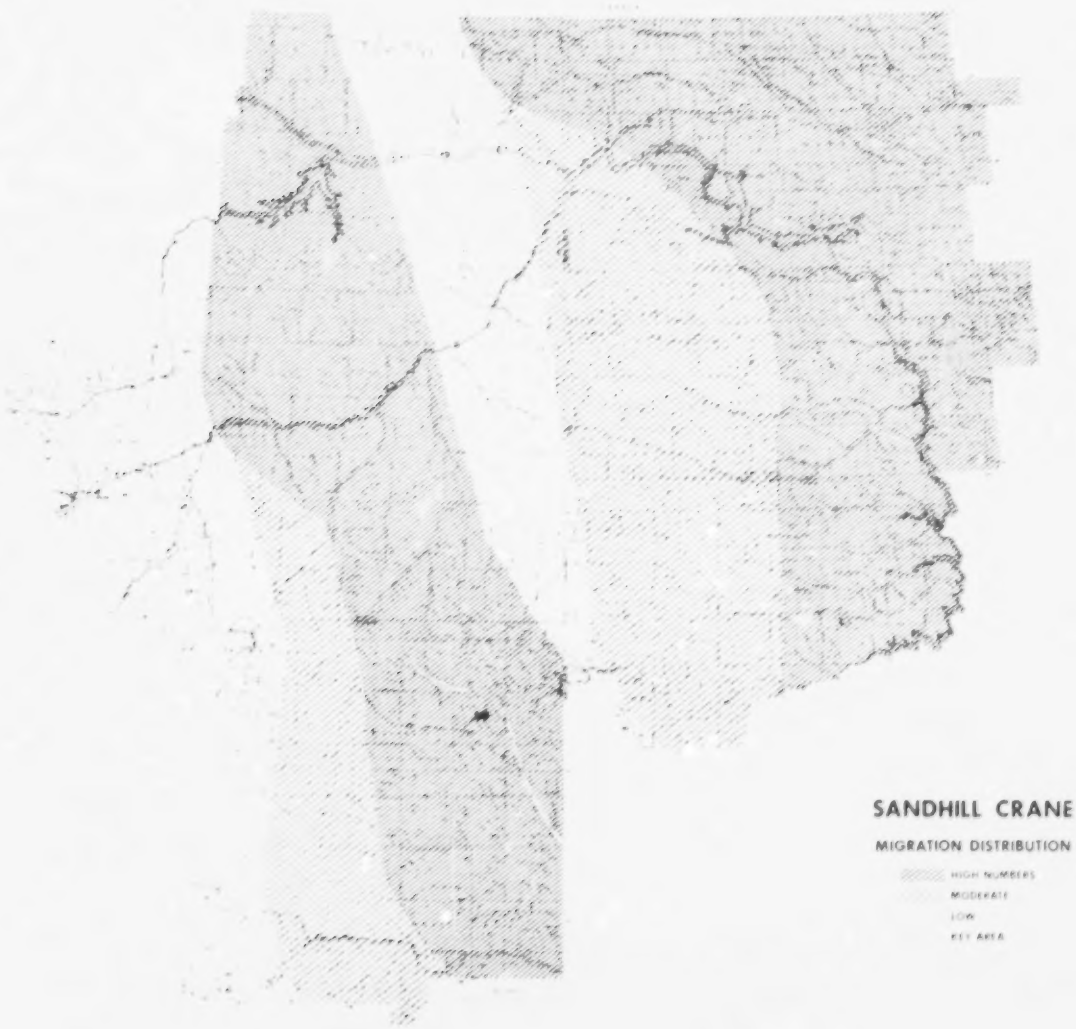

Figure 18. Sandhill crane migration distribution and key areas.

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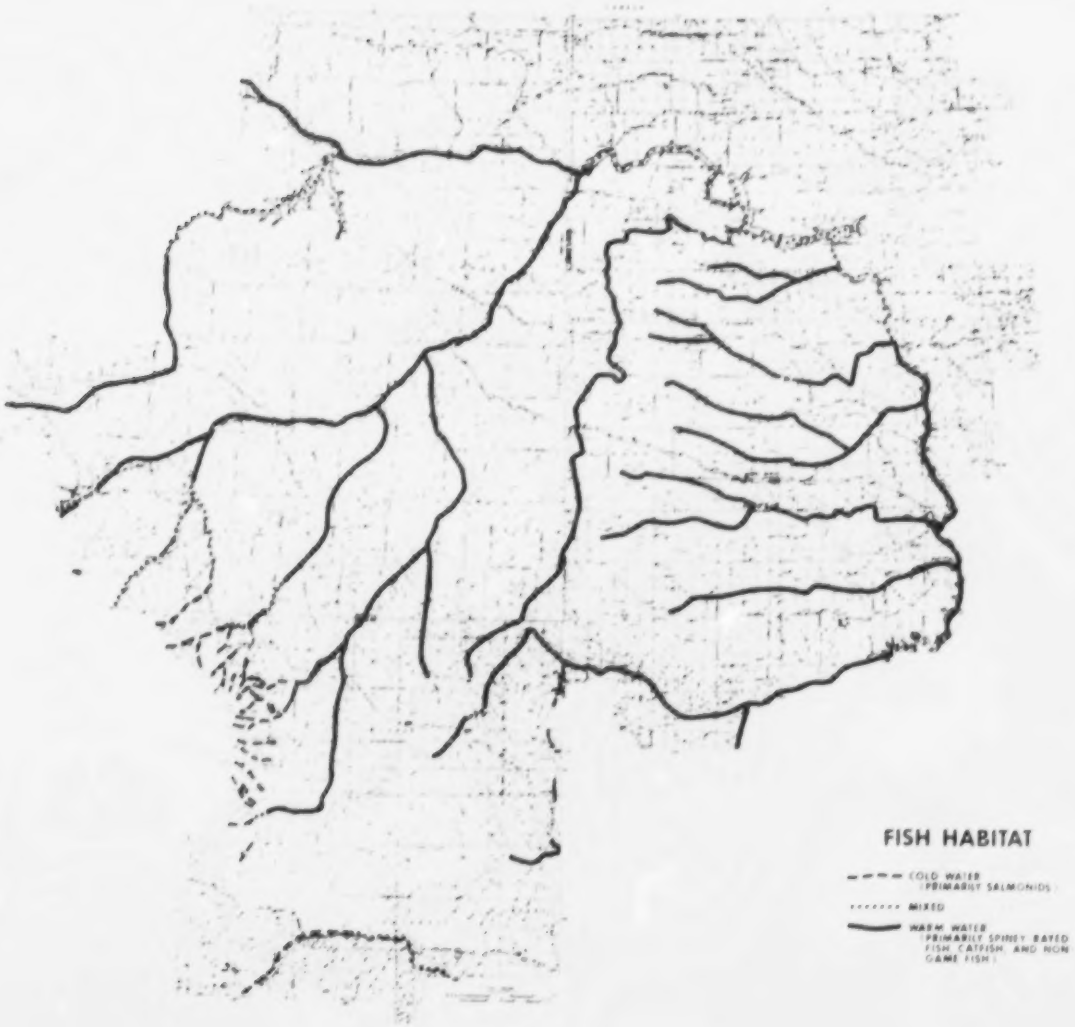

Figure 19. Fish habitat--cold water, mixed, and warm water species.

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Figure 20. Paddlefish--known and probable distribution.

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RECREATION

I. INTRODUCTION

The inventory of recreation resources, both potential and existing, is based on existing data. Information on such minor facilities as picnic tables and boat ramps was omitted. Of necessity, the classification of areas was applied on a total area basis, thus large areas may contain smaller ones, which, if delineated, might qualify for a different classification than that assigned the entire area.

A primary source of data was the Missouri River Basin Comprehensive Framework Study. State comprehensive outdoor recreation plans for each of the three key states were relied upon extensively for supplemental information.

The inventory placed emphasis on location, size, class, use, and quality characteristics. A general description of the study area is presented. A more detailed narrative was developed for the four selected sample areas: Campbell County, Wyoming; Big Horn and Rosebud Counties, Montana; and Mercer and Oliver Counties, North Dakota.

Seventy-eight potential recreation areas were identified in Montana, 44 in North Dakota, 15 in South Dakota, and 74 in Wyoming. The number of existing recreation areas identified by states are: Montana, 114 (5,928,704 acres); North Dakota, 418 (2,329,433 acres); South Dakota, 40 (513,307 acres); and Wyoming, 96 (4,690,939 acres). Potential recreation areas by states are listed and described in Table 1, and existing recreation areas are shown in Table 2 (Appendix E Plate 4).

II. PROCEDURES

Inventories of potential and existing recreation areas were made by counties in North and South Dakota, Wyoming, and Montana. The principal characteristics recorded for potential recreation areas include the name, total land and water area, water surface areas, significant features, types of use, and activities afforded. Characteristics noted for existing recreation include: quality and number of annual visits (when available), area name, ownership or administering agency, land and water areas, total area, and classification according to the BOR system.

Recreation resources are classified according to the Bureau of Outdoor Recreation classification system, which reflects degree of use and development, and indicates quality and uniqueness. The six classes used are: I - High density recreation areas; II - General outdoor recreation areas; III - Natural environment areas; IV - Outstanding natural areas; V - Wilderness and primitive areas; and VI - Historic and cultural sites.

Large acreages of Indian lands are included in the list of potential recreation areas. Their inclusion as potential areas is based upon the fact that most of these lands are not open for recreation use by the general public at the present time.

Existing data on privately owned recreation areas and facilities are insufficiently current and complete to merit

compilation and inclusion in this report. Hence, this is considered a significant information void in the NGPRP.

Identification and location of major existing and potential recreation areas is shown on the Land Ownership Status map. Precise locations of many of the smaller areas were unknown, and time constraints precluded determining this information for mapping.

Ultimately, both existing and potential recreation resources should be more specifically located, especially in those areas where developments are contemplated.

III. RESULTS

The Northern Great Plains Resources Program area, of nearly 92 million acres, consists of large open spaces interspersed with rugged scenic regions that afford widely diverse recreation opportunities. Of this total acreage, nearly 13.5 million acres were classified as existing recreation areas. These range from single-purpose designated recreation areas to extensive areas used for other purposes as well as recreation. Also important, but not included in the tabular data, are several rivers and trails that range from local to national importance in the recreation opportunities they afford. These and adjacent resources provide outdoor recreation pleasures, not only for the nearly 618,000 residents of the area, but they also attract millions of nonresident recreationists each

year. The importance of the Yellowstone National Park and high quality National Forest lands on the west and the Black Hills on the east cannot be overlooked as the major attractions that draw recreationists through the study area. Less than 1 percent of the study area is intensively developed for recreation.

Although 1,013,718 acres of water surface are included in the recreation inventory, most parts of the study area are deficient in water for recreation purposes. Most of the water surface acreage is consolidated in a few large reservoirs. The most notable are Oahe, Lake Sakakawea, Yellowtail, and Ft. Peck Reservoirs. By far the majority of existing recreation areas tabulated are in Class III, Natural Environment Areas. These are largely National Resource Lands, National Forest Lands, and Tribal lands that also provide other uses, especially grazing, as well as for extensive kinds of recreation activities. For the most part, these activities consist of sightseeing and driving for pleasure, hiking, fishing, hunting, nature study, camping, and picnicking.

Inasmuch as the area is sparsely settled and relatively few areas are intensively developed specifically for recreation, there is only a relatively small acreage classified as Class I and II. However, when the need becomes great enough, the potential exists for many Class III lands to be more fully developed to the point where they could become Class I or II.

It should be understood that all Class I--and especially Class II--lands are not identified in the tabular data. For instance, several campgrounds within the National Forest would qualify as Class II in a more detailed application of the classification system.

The study area contains a variety of resources of a unique nature or that are of historical or cultural value. Whether in Class IV, V, or VI, their importance is highlighted by the fact that once they are destroyed they cannot be recreated. Although all are important for outdoor recreation, their value is greater because they are part of the national heritage, or are a unique remaining vestige of nature's processes.

Except for nearly 5.6 million acres of tribal lands (considered as largely potential recreation lands) only a small percentage of the tabular data represents non-Federal or State recreation land. However, it is important to remember that the area also contains approximately 68 million acres of private nontribal land. In its broadest sense, a majority of this land should be considered as suitable for outdoor recreation, whether it be sightseeing, driving, rockhounding, hunting, fishing, snowmobiling, or some activity requiring more intensive supporting facilities. Unfortunately, reliable data are not available on the contribution that the private sector makes or has the potential to make to outdoor recreation in this area.

Animal and fishlife are most important assets to the recreation opportunities provided in the study area. They provide a base for hunting and fishing, for nature study, animal and bird watching, and to the enjoyment of other recreation activities such as sightseeing, hiking, and driving. The casual observer should realize that earlier this was one of the richest wildlife areas in North America, supporting a wide array of big game, small animal, and bird species. To preserve vestiges of the native prairie habitat, numerous refuges and management areas have been established. The largest is the Charles M. Russell National Wildlife Range that straddles the 125-mile-long Ft. Peck Reservoir.

Aside from the important physical and social benefits afforded by recreation resources of the area are the economic benefits related to the recreational use of these resources. In Wyoming, North Dakota, and Montana, recreation and tourism rank third in importance to the economy. Hunting of big game animals by nonresidents is a major industry in Wyoming and Montana. Admittedly, the resources west of the study area are the major inducements; however, their importance--economically--cannot be easily separated from the recreation resources within the study area.

Because coal development will likely be most concentrated in five counties (representing the four selected sample areas),

the remaining discussion will concentrate on the recreation resources of those counties.

Big Horn County, Montana. Big Horn County lies within planning region 7 of the State Comprehensive Outdoor Recreation Plan. Of the nearly 3.3 million acres of land and water in the county, 99,072 acres of land and 12,288 acres of water are classified as existing recreation resource. More than another 1.5 million acres, largely tribal lands, are listed as potentially suitable recreation acreage.

Recreation resources in the county range from the rugged Pryor Mountains and the spectacular Big Horn Canyon area in the west to rolling prairie country in the east. Natural vegetation varies widely from sagebrush and undifferentiated grasses to forest and alpine vegetation in the higher elevations. Cottonwoods, willows, and other deciduous trees and shrubs grow in the valleys.

A wide variety of animal and fishlife occur in the county. For example, the Pryor Mountains support a herd of bighorn sheep, the more common mule deer and elk, and the less common mountain lion. Many of these also occur at lower elevations, in addition to a variety of small game--most notably, pheasant and sharp-tailed grouse. The Yellowtail Reservoir, 50 miles in length, and streams in its immediate vicinity offer outstanding opportunities for fishing and other water-based recreation, and for picnicking, camping, and hiking.

All streams and valley bottoms are important recreation resources in this area. However, some are much more important

than others. The Big Horn River and the Tongue River are of regional significance. In fact, the Yellowtail Reservoir and the Big Horn River immediately below it probably approach national significance.

Big Horn County and nearby areas are some of the richest archaeological areas on the continent. Evidence indicates that aboriginal occupation extended back at least to 9,000 B.C. Before occupation by the Crow Indians in the 1700's, the area was frequented by other nomadic buffalo hunting tribes. Historic records and archaeologic evidence speak of Shoshoni, Blackfeet, Atsina, Cheyenne, and, possibly, Kiowa, in or near the Pryors following A.D. 500. The area is abundant in historic areas pertaining to the Indian culture and wars, in addition to sites relating to the early fur trading commerce.

Much of the thrust of human impact in the area has resulted from federally sponsored or sanctioned activity, since most of the area is managed and developed by four federal agencies: the Crow Reservation, under the Bureau of Indian Affairs; Big Horn Canyon National Recreation Area, under the National Park Service; Pryor Mountains Wild Horse Range and other public domain lands under the Bureau of Land Management; and Yellowtail Dam and power facilities under the Bureau of Reclamation.

Most recreation resources in the county are Class III Natural Environment Areas. Most of this acreage consists of the more than 27,000 acres of Natural Resource Lands, and

nearly 1.6 million acres of tribal lands. Most private lands in the county should be considered a resource that presently or in the future can provide recreation opportunities. These now are being inventoried jointly by the National Association of Conservation Districts, the Soil Conservation Service, and the Bureau of Outdoor Recreation.

As previously noted, there are many Class VI historical and archaeological sites in the county. The 765-acre Custer Battlefield National Monument is probably the best known. Maintaining the natural character of the areas surrounding this and other existing and potential sites is important to achieving a true understanding and appreciation of them.

Rosebud County, Montana. Rosebud County lies within planning region 3 of the State Comprehensive Outdoor Recreation Plan. Of the more than 3.2 million acres of land in the county, 238,739 acres of land and 75 acres of water are reported as existing recreation resource. More than 235,500 additional acres, primarily tribal land, are listed as potentially suitable recreation acreage.

More than any other region in Montana, the southeastern counties--including Rosebud--still evoke the characteristics and traditions of the Old West. Miles City is the focal point of the area, and often is referred to as the "Cowboy Capitol of the Nation." The daily activities of the many ranching enterprises still in operation preserve the heritage and traditions of the cattle empire.

The dominant physical characteristic of the county is the sense of vast distances and open space. Even so, there is considerable variation in topography. Typically, there are flat-to-rolling prairies, rough breaks, badlands, narrow and broad river flood plains, and low hills. Natural vegetation consists of undifferentiated grassland, sagebrush and saltbush areas, and ponderosa pine and open woodland forest. The open pine forest, interspersed with grass meadows, is located mostly in the hilly area in the south. Deciduous trees, cottonwoods, ash, boxelder, and willows occupy the stream flood plains.

Water resources for recreation in this county are extremely limited; the Yellowstone River and its environment being the most significant river in the county. It is the most densely populated area, and is a main travel route. The Tongue River also traverses some very scenic areas and provides a considerable amount of recreation opportunity. Both the Yellowstone and the Tongue Rivers have attributes that make them at least of regional interest for recreation.

Rosebud County is part of a broader area that is considered one of the best mule deer areas in the State. It contains an excellent habitat of open country, with a supply of browse plants interspersed with escape cover of moderate-to-heavy timber and brushy draws and coulees. Another species that provides hunting opportunities is the wild turkey. Excellent

habitat occurs in the dense growths of ponderosa pine and irregular topography of the Custer National Forest.

Most of the recreation resources of the county are considered as Class III, Natural Environment Areas. These lands consist of the more than 233,000 acres of Natural Resource Lands, nearly 96,000 acres of the Custer National Forest, and the potentially usable Indian tribal lands of nearly 236,000 acres. In addition, private lands in the county should be considered as a recreation resource suitable for providing recreation opportunities. The county also contains a large number of historic sites that have potential for permanent protection and preservation. They do not involve large acreage, but are significant because they are unique. Although most Class VI sites may be small, maintaining the general character of the surrounding lands is important to appreciation and understanding of most of these areas.

Campbell County, Wyoming. Campbell County lies within planning region 3 of the State Comprehensive Outdoor Recreation Plan. Of the more than 3 million acres of land in the county, 381,064 acres of land and 445 acres of water are classified as existing recreation resource. Only three areas are listed as potentially suitable for recreation. However, most of the privately owned land in the county either is currently providing recreation opportunities or has such a potential.

The topography is a continuation of that described for Rosebud County, Montana, but it presents a much different character. It is flat-to-rolling open sagebrush and grassland for the most part, and is less broken by stream valleys. It is the headwater of streams flowing--many intermittently--to most points of the compass. The largest stream is the Belle Fourche. Most trees are located along these valley bottoms. Big game animals, especially antelope, and upland game birds are prime sources of recreation opportunity in this area.

The most extensive existing recreation resources are the Class III Natural Environment Areas composed of more than 223,000 acres of Natural Resource Lands and more than 158,000 acres of National Grassland. Hunting, sightseeing, and driving for pleasure are probably the most common recreation activities. There are less than 100 acres of developed recreation land in this county.

Two areas in the county have the potential for designation as National Landmarks. They are Pumpkin Butte (in the southwest corner of the county) and Rozet Escarpment (east of Gillette). Dr. George Frison, Archaeological Department, University of Wyoming, in cooperation with the Wyoming Recreation Commission, presently is researching the area for archaeological sites.

Mercer and Oliver Counties, North Dakota. Of the 1,176,960 acres of land and water contained within Mercer and Oliver Counties, only 5,801 acres are classed as existing recreation area. Another 28,079 acres, largely tribal land, are listed

as a potential recreation resource. Much of the remaining private land also should be considered as a base for at least the more extensive recreation activities, such as hunting, sightseeing, and driving for pleasure.

The water acreage of the adjacent Missouri River and Lake Sakakawea provides the attraction for most of the recreation development in this area; however, this extensive water acreage is not tabulated separately for these two counties. Only 484 acres of other water, mostly in small farm ponds, is shown as available for recreation.

This area is characterized by grass-covered rolling-to-hilly terrain, dissected by several small-to-medium sized, tree-lined streams. Many of the streams are bordered by bluffs. Most of the area is privately owned and supports a grazing economy. Cultivated crops are interspersed throughout the area where conditions are suitable.

The area supports populations of both mule and white tail deer and small game that afford hunting opportunities. The latter include both sharp-tailed and Hungarian partridge in upland areas. There also is fair to good ring-necked pheasant hunting along creek and bottom land. It is the adjacent water areas--especially Lake Sakakawea--that provide a base for extensive water-based recreation activities. Fishing and boating opportunities are most prevalent. Most of the developed picnic and campgrounds occur along these

shores. The largest is the 661-acre Lake Sakakawea State Park, which has annual visits of almost 80,000 people.

Unlike the other sample counties, most of the existing recreation areas in Mercer and Oliver Counties are small and most contain some recreation development. For this reason, there are a greater number in the Class II category and fewer in Class III. This contrasts sharply with the extensive Class III acreage that occurs in the other sample counties. The major reason, of course, is the minor acreage of public land in this two-county area. Although use figures are not available for most of the areas, it is safe to assume that most of the recreation sites in this area, being water oriented and close to several urban populations, are more intensively used than those in the other sample counties.

The Missouri River is especially important because of its having been a major route for early exploration and settlement of the northwest. Sites related to Indian settlement, exploration, and fur trading occur frequently along the river and its environs, and are important vestiges of the past. They are particularly important attractions for recreationists. One of the most important sites is Ft. Clark, an important fur trading post in the early 1800's. It also was the site where smallpox decimated the Mandan Indian Tribe in 1837.

Currently, the Lewis and Clark Trail is being studied for its potential inclusion in the National Trail System. Their

route in 1804 traversed the eastern edge of Mercer and Oliver Counties. The North Country Trail as it is now proposed would traverse the north edge of Mercer County.

An area with potential as a National Historic Site is the Knife River Indian Villages in Mercer County. The tract proposed for the National Historic Site contains four earth lodge Indian village ruins ranging in age from about 1500 to 1845 which provide a complete cross section of interacting Indian and European-American cultures in the Middle Missouri River frontier. Big Hidatsa Village, the largest of five Indian village sites in the area and occupied from 1740 to 1845, would be an integral part of the proposed Knife River Indian Villages National Historic Site. This would also include the Middle Hidatsa Site which has been established as the home of Sakakawea and her husband, Toussaint Charbonneau at the time Lewis and Clark were encamped in the area. The Charbonneau's accompanied Lewis and Clark to the west coast.

Table 1.--Potential recreation areas and their principal characteristics by states

MONTANA	Number on map	Acreage: Total land and water within area	Acreage: Water surface	Significant Features: Lake	Significant Features: Seashore	Significant Features: River	Significant Features: Reservoir	Significant Features: Forest	Significant Features: Prairie	Significant Features: Desert	Significant Features: Mountains	Significant Features: Geological	Significant Features: Historical or archeological	Significant Features: Scenic	Type of Use: Day or weekend	Type of Use: Week-end	Type of Use: Overnight-short stay	Type of Use: Long trip or route	Activities: Swimming	Activities: Fishing and hunting	Activities: Sailing	Activities: Water skiing	Activities: Boating	Activities: Hiking	Activities: Nature study	Activities: Other sports	Activities: Other outdoor recreation	Class
BIG HORN COUNTY:																												
Indian Reservation Lands	1*	1,524,919				X	X		X	X		X	X	X	X	X	X	X	X	X	X			X	X	X	X	[illegible]
Rosebud Battlefields HS	2	640							X	X			X		X			X							X			[illegible]
Mott Creek Fossil Site N.L.	3*									X				X	X										X			[illegible]
U. of Oklahoma	3*									X				X	X										X			[illegible]
Amer. Museum Locality	3*									X				X	X										X			[illegible]
Thor Lande Site	3*									X				X	X										X			[illegible]
Rattlesnake Site	3*									X				X	X										X			[illegible]
Cloverleaf Formation	3*									X				X	X										X			[illegible]
CARTER COUNTY:																												
Indian Reservation Lands	4*	620							X	X			X	X	X		X			X	X				X	X		[illegible]
Deadwood Stage Rte. H.S.	5									X				X	X			X							X			[illegible]
Stoneville Gunfight H.S.	6	5								X				X	X			X							X			[illegible]
Powder Hill Fossil Site N.L.	7*									X				X	X										X			[illegible]
Capitol Rock	7									X				X	X										X			[illegible]
CUSTER COUNTY:																												
Ft. Keogh - Bismarck Stage Route H.S.	8									X				X	X			X							X			[illegible]
Cole Walker Battle Sites H.S.	9									X				X	X			X							X			[illegible]
Ft. Keogh H.S.	10	35,000					X			X				X	X			X	X	X	X				X	X		[illegible]
Lewis & Clark Expedition H.S.	11						X							X	X			X							X			[illegible]

*Location by county only.
H.S. Historic Site
N.L. National Landmark

Table 1 (Cont'd)

MONTANA	Number on map	Acreage: Total land and water within area	Acreage: Water surface	Significant Features: Lake	Significant Features: Reservoir	Significant Features: River	Significant Features: Pond	Significant Features: Prairie	Significant Features: Forest	Significant Features: Mountains	Significant Features: Wildlife	Significant Features: Area of archeological interest	Type of Use: Wilderness	Type of Use: Primitive	Type of Use: Semi-Primitive Outdoor	Type of Use: Intensive Use	Activities: Hunting and Fishing	Activities: Camping	Activities: Boating	Activities: Swimming	Activities: Hiking	Activities: Nature Study	Activities: Photography	Activities: Other
DANIELS COUNTY:																								
Indian Reservation Lands	12*	34,331						X				X		X				X				X		
Flaxville Plain N.L.	13							X					X	X								X		
DAWSON COUNTY:																								
Lewis & Clark Exp. H.S.	11	See Custer County																						
Clark Campsite H.S.	14					X						X		X		X						X		
Hagen Site H.S.	15	20						X				X		X		X						X		
FALLON COUNTY:																								
Ft. Keogh - Bismarck Stage Route H.S.	8	See Custer County																						
GARFIELD COUNTY:																								
Bone Trail H.S.	16							X				X		X		X		X				X		
Garbani Paleontologic Site	17	40						X				X		X		X						X		
McDonald Location	18	80						X				X		X		X						X		
7 Blackfoot Rec. Area	19	21,520					X	X				X	X			X	X	X	X			X		X
Kid Curry's Hideout HS	20							X				X		X		X						X		
Smoky Butte N.L.	21*							X					X									X		
Brownie Butte N.L.	21*							X					X									X		
Mammal Hill Fossil Area N.L.	21*							X					X									X		
Rock Creek Locality N.L.	21*							X					X									X		
Crooked Creek Fossil Area N.L.	22*							X					X									X		
Crooked Creek Mammal Site N.L.	22*							X					X									X		
MC CONE COUNTY:																								
Indian Reservation Land	23*	1790				X		X				X	X		X		X	X			X	X	X	
Tyrannosaurus Locality N.L.	24							X					X									X		
McKenna Hollow N.L.	25*							X					X									X		
Harbicht Hill N.L.	25*							X					X									X		

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Table 1 (Cont'd)

MONTANA	Number on map	Acreage: Total land and water within area	Acreage: Water surface	Significant Features: Lake	Significant Features: Rockwork	Significant Features: River	Significant Features: Seashore	Significant Features: Volcanic	Significant Features: Prairie	Significant Features: Forest	Significant Features: Mountains	Significant Features: Historical	Significant Features: Historical or archeological	Significant Features: Geological	Type of Use: Day and weekend	Type of Use: Vacation	Type of Use: Center-state target	Type of Use: Vacation on route	Activities: Hunting and fishing	Activities: Camping	Activities: Boating	Activities: Swimming	Activities: Winter sports	Activities: Nature study	Activities: Winter sports	Activities: Interpretive experience	Class
POWDER RIVER COUNTY:																											
Stag Rock H.S.	26	5						X				X	X		X			X						X			II
Needle Rock H.S.	27	5						X				X	X		X			X						X			II
Reynolds Battle Site HS	28								X				X		X			X						X			VI
Deadwood Stage Rte. HS	5	See Carter Co.																									
Elkhorn City HS	29								X				X		X			X						X			VI
Glover-Sioux Battle HS	30								X				X		X			X						X			VI
Cole Walker Battle Sites H.S.	9	See Custer Co.																									
Reynolds Campsites	28								X				X		X			X						X			VI
PRAIRIE COUNTY:																											
Sheridan Butte H.S.	29	160							X				X		X			X						X			VI
XIT Ranch HDQ. HS	30	5							X				X		X			X						X			VI
Cherry Crk. Res. Rec.	31		340		X				X						X		X	X		X		X					II
Terry Back Country Rec.	32	32,360							X	X				X	X		X	X	X				X				V
Pine Ridge Back Country Recreation Area	33	4,480						X							X		X	X	X	X							
Lewis & Clark Exp. H.S.	11		See Custer Co.																								
Ft. Keogh-Bismarck State Rte.	8		See Custer Co.																								
RICHLAND COUNTY:																											
Indian Reservation Land	34*	157							X				X		X			X	X				X	X			III
Lewis and Clark Exp. H.S.	11		See Custer County																								
ROOSEVELT COUNTY:																											
Indian Reservation Land	37*	486,123			X	X			X				X		X			X	X			X	X	X			III
ROSEBUD COUNTY:																											
Indian Reservation Land	38*	235,523				X		X	X			X	X	X	X	X	X	X	X	X		X	X	X		X	III
Battle of Wolf Mtn. H.S.	39								X				X		X			X						X			VI
Battle of Hanging Woman Creek H.S.	40							X	X				X		X			X						X			VI
Ft. Sarpy I H.S.	41					X			X				X		X			X						X			VI
Ft. Alexander H.S.	42					X			X				X		X			X						X			VI
Texas or Northern Trail H.S.	43								X				X		X			X						X			VI
Ft. Keogh-Ft.Custer Trail H.S.	44								X				X		X			X						X			VI
Ft. Van Buren H.S.	45	Trace				X			X			X	X		X			X						X			VI
Castle Rock H.S.	46	2							X				X		X			X						X			VI
Clark Campsite H.S.	47					X							X		X			X						X			VI
Honsinger Fight H.S.	48	120							X				X		X			X						X			VI

Table 1 (Cont'd)

MONTANA	Number on map	Acreage: Total land and water within area	Acreage: Water surface	Significant Features: Lake	Significant Features: Reservoir	Significant Features: Wildlife	Significant Features: Scenic	Significant Features: Cultural	Significant Features: Recreational	Significant Features: Geological	Significant Features: Archaeological or archaeological	Significant Features: Scenic	Type of Use: Day Use	Type of Use: Overnight Use	Type of Use: Boating	Type of Use: Fishing	Activities: Hunting	Activities: Fishing	Activities: Boating	Activities: Swimming	Activities: Hiking	Activities: Nature study	Activities: Cultural	Activities: Other	Other
SHERIDAN COUNTY:																									
Indian Reservation Land	49*	51,704						X			X	X			X		X				X				X
Medicine Lake N.L.	50							X				X									X				X
Antelope N.L.	50							X				X									X				X
Medicine Lake NWR	51							X		X											X				X
TREASURE COUNTY:																									
Indian Reservation Land	52*	16,776						X			X	X			X		X				X				X
Ft. Keogh Site N.S.	53				X			X				X									X				X
Ft. Sarpy 2 H.S.	54				X			X			X	X			X						X				X
VALLEY COUNTY:																									
Indian Reservation Land	55*	327,116			X	X		X		X	X	X			X		X				X	X			X
Flaxville Plain	13							X				X									X				X
YELLOWSTONE COUNTY:																									
Indian Reservation Land	56*	149,812			X		X	X		X		X	X	X	X	X	X	X			X	X	X		X

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Table 1 (Cont'd)

NORTH DAKOTA	Number on map	Acreage: Total land and water within area	Acreage: Water surface	Significant Features: Lake	Significant Features: Reservoir	Significant Features: River	Significant Features: Seashore	Significant Features: Forest	Significant Features: Prairie	Significant Features: Desert	Significant Features: Mountains	Significant Features: Biological	Significant Features: Historical or archeological	Significant Features: Geological	Type of Use: Day and weekend	Type of Use: Vacation	Type of Use: Out-of-State target	Type of Use: Tourist en route	Activities: Fishing	Activities: Hiking and riding	Activities: Camping	Activities: Boating	Activities: Swimming	Activities: Fishing	Activities: Hunting	Activities: Nature study	Activities: Water sports	Activities: Wilderness experience	Class
ADAMS COUNTY:																													
Indian Reservation Land	1*								X						X					X						X			II
BILLINGS COUNTY:																													
Bullion Butte N.L.	2								X			X														X			IV
E.River Road Medora to Amidon-Scenic Drive	3*	40 mi.							X			X	X	X	X				X	X	X				X	X			II
Little Mo. Scenic River	3a					X			X			X	X	X	X			X	X	X	X					X	X	X	IV
BOTTINEAU COUNTY:																													
Turtle Mtn. Wetlands	4								X					X												X			IV
BURKE COUNTY:																													
Des Lacs NWR	5			X								X																	IV
Lostwood NWR	6			X								X																	IV
BURLEIGH COUNTY:																													
Larson Indian Village Monument	7	4							X				X																VI
DIVIDE COUNTY:																													
Indian Reservation Land	8*	639							X						X					X						X	X		III
DUNN COUNTY:																													
Killdeer Mountains	9	20,000						X	X			X	X	X				X		X						X	X		IV
Killdeer Mtn. Gap Road Scenic Drive	10	12 mi.							X			X	X	X															II
Hwys. 22-23, Killdeer to New Town Scenic Dr.	11	64							X			X		X				X		X	X					X	X		IV
Indian Reservation Land	12*	199,758		X	X	X			X			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		III
Little Mo. Scenic River	3a				See Billings County																								
GOLDEN VALLEY COUNTY:																													
Sentinel Butte N.L.	13								X					X												X			IV
Marmarth to Golva Scenic Drive	14*	36 mi.				X				X		X		X		X			X	X						X	X		II
KIDDER COUNTY:																													
Sibley Lake N.L.	15								X					X												X			IV
Long Lake N.W.R.	15a			X					X			X			X					X	X					X			III

Table 1 (Cont'd)

NORTH DAKOTA	Number on map	Acreage: Total land and water within area	Acreage: Water surface	Significant Features: Lake	Significant Features: Rolling Hills	Significant Features: Prairie	Significant Features: Forests	Significant Features: Wetlands	Significant Features: Historical or archeological	Significant Features: Wildlife	Type of Use: Day use	Type of Use: Overnight	Type of Use: Year-round	Activities: Hiking	Activities: Bicycling	Activities: Camping	Activities: Picnicking	Activities: Boating	Activities: Fishing	Activities: Hunting	Activities: Swimming	Activities: Wildlife observation	Activities: Scenic drives	Activities: Other
MC HENRY COUNTY:																							
Karlsruhe Bay	16					X					X												
J.Clark Salver NWR	17					X		X			X										X		
Lower Souris NWR	17					X		X			X										X		
MC KENZIE COUNTY:																							
Indian Reservation Land	18*	80,145		X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X		
Grassy Butte W.L.	19					X			X												X		
87-23, Killdeer to																							
Scenic Dr.	11	See Dunn Co.																					
Scenic River	2a	See Billings County																					
Reservation Land	20*	91,363		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		
MERCER COUNTY:																							
Indian Reservation Land	21*	27,012		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Knife R. Ind. Village NHS	39	1,067				X		X	X	X		X	X										
MORTON COUNTY:																							
Hwy. 1806, Mandan to Ft.																							
Rice Scenic Drive	22	28-41			X	X		X	X	X	X			X	X	X	X	X	X	X	X		
Glen Ullin Clinker W.L.	23					X				X													
Mo. River Valley & Oahe																							
Res. Recreation Area	24			X	X	X		X	X	X	X			X	X	X	X	X	X	X	X		
MOUNTRAIL COUNTY																							
Indian Reservation Land	25*	21,346		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Palermo Saline Wetlands	26*					X				X											X		
Hwy. 1804, New Town to																							
Williston - Ft. Union																							
Scenic Drive	27			X		X			X			X	X	X	X	X			X	X	X		
SIOUX COUNTY																							
Indian Reservation Land	28*	293,221		X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X		
Sioux Grasslands	29*					X			X												X		
Mo. River Valley & Oahe																							
Res. Rec. Area	24	See Morton Co.																					

Table 1 (Cont'd)

NORTH DAKOTA	Number on map	Acreage: Total land and water within area	Acreage: Water surface	Significant Features: Lake	Significant Features: Reservoir	Significant Features: River	Significant Features: Seashore	Significant Features: Forest	Significant Features: Prairie	Significant Features: Desert	Significant Features: Mountains	Significant Features: Biological	Significant Features: Historical or archeological	Significant Features: Geological	Type of Use: Day and weekend	Type of Use: Vacation	Type of Use: Out-of-State target	Type of Use: Tourist en route	Activities: Pleasing	Activities: Hiking and riding	Activities: Camping	Activities: Boating	Activities: Hunting	Activities: Fishing	Activities: Mining	Activities: Nature study	Activities: Winter sports	Activities: Wilderness experience	Class
SLOPE COUNTY:																													
Burning Coal Veins	30							X	X			X		X				X		X									IV
Columnar Juniper Rec. Area -Ponderosa Pine	30							X	X			X		X				X		X					X	X			IV
Chalky Buttes Park Area	31	1,600							X	X		X		X						X					X	X			III
Limber Pine Site	32											X																	IV
Marmarth-Golva Sc.Dr.	14	See Golden Valley Co.																											
E. River Road, Medora to Amidon Scenic Drive	3*	See Billings Co.																											
Little Mo. Scenic River	3a	See Billings Co.																											
White Butte N.L.	34								X					X												X			IV
STARK COUNTY:																													
Little Badlands Pk Ar.	33	640							X	X		X	X	X						X					X	X			IV
WILLIAMS COUNTY:																													
Indian Reservation Land	35*	8,076							X				X		X			X		X					X	X			III
Hwy 1804, New Town-Williston-Ft.Union Scenic Drive	27	See Mountrail Co.																											
Fort Buford H.S.	37					X			X				X		X			X								X			I

Table 1 (Cont'd)

SOUTH DAKOTA	Number on map	Acreage: Total land and water within area	Acreage: Water surface	Significant Features: Lake	Significant Features: Reservoir	Significant Features: River	Significant Features: Seashore	Significant Features: Forest	Significant Features: Prairie	Significant Features: Desert	Significant Features: Mountains	Significant Features: Historical site or archeological site	Significant Features: Geological	Type of Use: Wildlife Refuge	Type of Use: Fishing	Type of Use: Outdoor-Recreation	Type of Use: Tourist Pass Route	Activities: Hiking	Activities: Camping	Activities: Hunting	Activities: Fishing	Activities: Boating	Activities: Swimming	Activities: Sightseeing	Activities: Nature Study	Activities: Other Outdoor Recreation	Class
BUTTE COUNTY																											
Battle Creek Tepee Rings	1	80							X				X		X		X		X						X		III
CORSON COUNTY:																											
Indian Reservation Land	2*	539,169			X	X			X			X	X	X	X	X	X	X	X	X	X	X	X	X	X		III
DEWEY COUNTY:																											
Indian reservation Land	3*	845,358			X	X			X			X	X	X	X	X	X	X	X	X	X	X	X	X	X		III
HARDING COUNTY:																											
Slim Buttes N.L.	4*												X	X													IV
Short Pine Hills Fossils	5*							X	X					X	X		X	X	X	X				X	X	X	IV
Jumpoff Locality N.L.	6*								X					X												X	IV
MEADE COUNTY																											
Indian Reservation Land	6*	160							X				X		X		X		X					X	X		III
Little Sundance Hill NL	7*								X					X											X		IV
Barosaurus Locality NL	7*								X					X											X		IV
Ft. Meade Site NL	8*								X					X											X		IV
Ft. Meade Relic Natural Site	9*								X			X												X		IV
South Stage Barn Canyon NL	10*								X			X												X		IV
Bear Butte Addition	11	3,000							X					X	X		X	X	X					X	X		III
PERKINS COUNTY:																											
Indian Reservation Land	12*	640							X				X		X		X		X					X	X		III
ZIEBACH COUNTY:																											
Indian Reservation Land	13*	556,341		X	X	X			X			X	X		X	X	X	X	X	X	X	X	X	X	X	X	III

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Table 1 (Cont'd)

WYOMING	Number on map	Acreage: Total land and water within area	Acreage: Water surface	Significant Features: Lake	Significant Features: Reservoir	Significant Features: River	Significant Features: Seashore	Significant Features: Forest	Significant Features: Prairie	Significant Features: Desert	Significant Features: Mountains	Significant Features: Biological	Significant Features: Historical or archeological	Significant Features: Geological	Type of Use: Day and weekend	Type of Use: Vacation	Type of Use: Out-of-State target	Type of Use: Tourist en route	Activities: Picnicking	Activities: Hiking and riding	Activities: Camping	Activities: Boating	Activities: Swimming	Activities: Fishing	Activities: Hunting	Activities: Nature study	Activities: Winter sports	Activities: Wilderness experience	Class
CAMPBELL COUNTY:																													
Pumpkin Butte N.L.	1								X					X	X			X								X			IV
Rozet Escarpment NL	2								X					X	X			X								X			IV
State 59 Scenic Road	3	100mi								X		X	X	X	X	X			X	X	X				X	X		X	III
CONVERSE COUNTY:																													
Box Elder Cave N.L.	4								X					X	X			X		X						X			IV
Ayers Natural Bridge NL	5								X					X	X			X		X						X			IV
State 59, Scenic Road	3	See Campbell				Co.																							
State 94, Douglas to Esterbrook Scenic Road	6	24 mi						X	X		X			X	X			X	X	X	X				X	X	X		III
Glenrock Buffalo Jumps	7	20							X				X		X	X	X	X	X							X			VI
Deer Creek Stage Station	8	30				X			X				X		X	X	X	X	X	X	X			X		X			VI
CROOK COUNTY:																													
Louis Schneider Grave	9	1											X		X					X									VI
Welcome (Town Site)	10	2											X		X					X									VI
Mineral Hill	11	2											X		X					X									VI
Inyan Kara	12	1,280											X	X			X									X			IV
Missouri Buttes	13													X	X			X								X			IV
Sundance Mtn.	14													X	X			X								X			IV
US 14, Devils Tower S.R.	15	64 mi				X		X	X		X	X		X	X			X	X	X	X			X	X	X	X		III
US 585, Newcastle to Sundance Scenic Rd.	16	47 mi				X		X	X		X	X		X	X	X	X	X	X	X	X			X	X	X	X		III
US 116, Upton to Sundance Scenic Rd.	17	30 mi						X	X		X	X		X	X			X	X						X	X			III
Pine Ridge Road Sc. Dr.	18	10 mi						X	X		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		III
Vare Buffalo Jump	19	30							X				X		X	X	X	X	X	X	X								VI
JOHNSON COUNTY:																													
Petrified Forest Mon.	20	960							X					X	X			X											III
N.Fork Powder R. Prim. Area	21	22,400				X					X	X		X	X	X				X	X			X	X	X		X	V
Red Fork Fossil Area	22													X															IV
Story to I-90 South	23	4 mi.				X			X				X		X			X	X	X	X			X	X	X			III
Soldier Park Graves	24	1									X		X		X					X									VI
Sourdough Tie Dam	25	1									X		X		X					X									VI
Elgin Park Grave	26	1									X		X		X					X									VI
Hospital Hill	27	2									X		X					X		X									VI
Indian Face	28	1									X			X	X					X									VI
Crazy Woman Canyon Indian Dwelling	29	1									X		X		X					X									VI
Bomber Mtn. Monument	30	2									X		X			X				X									VI
Tin Camp	31	2									X		X																VI

Table 1 (Cont'd)

WYOMING	Number on map	Acreage: Total land and water within area	Acreage: Water surface	Significant Features: Lake	Significant Features: Reservoir	Significant Features: Dam	Significant Features: Hydroelectric	Significant Features: Irrigation	Significant Features: Canals	Significant Features: Monuments	Significant Features: Historical or archeological	Significant Features: Trail	Type of Use: Day	Type of Use: Overnight	Type of Use: Long term	Type of Use: Seasonal	Activities: Hunting	Activities: Fishing	Activities: Boating	Activities: Swimming	Activities: Hiking	Activities: Riding	Activities: Camping	Activities: Picnicking	Activities: Sightseeing	Activities: Other
NATRONA COUNTY:																										
Sweetwater River	32					X					X	X					X							X		X
Independence Rock N.L.	33											X					X									X
Bates Hole N.L.	34*							X				X					X							X		X
Hell's Half Acre N.L.	35							X				X					X									X
Devil's Gate N.L.	36	95				X		X		X		X	X	X	X	X	X				X	X	X			X
Split Rock N.L.	37											X														X
Rattlesnake Hills N.L.	38									X		X														X
Casper Buffalo Trap	39	20						X			X		X	X	X											X
Red Butte's Battleground	40	20						X	X		X		X	X	X	X	X									X
Bridger Trail	41	1						X			X		X	X	X											X
Alcova Res. Loop Road	42	45mi.			X	X		X			X	X	X	X			X	X		X	X	X				X
Casper Mtn. Loop Road																										
Scenic Road	43*	50mi.					X	X		X	X		X	X		X	X	X				X	X			X
NIOBRARA COUNTY:																										
Spanish Diggings	44	1,800						X			X	X			X											X
Hat Creek Breaks	45*							X				X					X							X		X
Flat Creek Breaks	46*							X				X					X							X		X
Hat Creek Stage Station	47	10						X			X		X	X	X	X		X								X
SHERIDAN COUNTY:																										
Fetterman Massacre	48	10						X			X		X	X	X	X	X									X
Wagon Box Fight	49	1						X			X		X	X	X	X	X									X
Tongue River Canyon	50	540			X	X	X			X	X	X	X		X	X	X			X	X	X	X			X
U.S.14, Shell Canyon																										
Scenic Road	51	65 mi.				X	X			X	X		X	X		X	X	X	X			X	X	X		X
Banner-Story Scenic R.	52	5 mi.				X	X	X		X	X	X	X				X	X	X	X		X	X	X		X
Splash Dam	53	2								X		X	X			X										X
Tepee Indian Campsite	54	3								X		X	X				X									X
Tie Flume	55	4								X		X	X			X										X
Fallen City	56	2								X			X	X		X										X
Tongue River Cave	57	2								X			X	X			X									X
Garden of the Gods	58	5								X			X	X			X									X
Perry Cabin	59	1								X		X	X			X										X
Woodrock Guard Sta.	60	2								X		X	X			X										X
Little Tongue Sinks	61	5								X			X	X			X									X
Wolf Creek Falls	62	3								X			X	X			X									X
Steamboat Point	63	4								X		X	X			X										X
Arney's Cross	64	1								X		X	X				X									X
Sibley Battle Field	65	5								X		X	X				X									X
Sucker Cr. Miners' Camp	66	3								X		X	X			X										X
Burgess Chipping Ground	67	2								X		X	X			X										X
Prospect Cr. Campsite	68	3								X		X	X				X									X
Camp Creek Campsite	69	3								X		X	X				X									X
Freezeout Artifacts	70	4								X		X	X				X									X
Little Tongue Campsite	71	4								X		X	X			X										X

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Table 1 (Cont'd)

WYOMING	Number on map	Acreage: Total land and water within area	Acreage: Water surface	Significant Features: Lake	Significant Features: Reservoir	Significant Features: River	Significant Features: Seashore	Significant Features: Forest	Significant Features: Prairie	Significant Features: Desert	Significant Features: Mountains	Significant Features: Biological	Significant Features: Historical or archeological	Significant Features: Geological	Type of Use: Day and weekend	Type of Use: Vacation	Type of Use: Out-of-state target	Type of Use: Tourist en route	Activities: Picnicking	Activities: Hiking and riding	Activities: Camping	Activities: Boating	Activities: Sailing	Activities: Fishing	Activities: Engine	Activities: Nature study	Activities: Winter sports	Activities: Wilderness experience	Class
WESTON COUNTY:																													
Seven Mile Creek Fossil Site	72*								X					X						X						X			IV
Clifton Canyon Natural Area	73	1,260						X			X			X	X					X	X				X	X		X	IV

Northern Great Plains Resources Program
Surface Resources Work Group

Draft
February 1974

STATE: MONTANA

Table 2.--Existing recreation areas and principal characteristics by states

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Big Horn	Nat'l Resource Lands	Federal	BLM	27,208				27,208			x			
M		"	Crow Indian Reserva.	Tribal	BIA	66,676	75		583	67,334			X			*
M		"	" " "	Federal	BIA	392	5		750	1,147			X			
H	118,836	"	Big Horn Canyon NRA	Federal	NPS	2,110	1,090		5,760	8,960		x				
H	387,717	"	Custer Battlefield Nat'l Monument	Federal	NPS	749	16			765						x
M	5,000	"	Chief Plenty Coups Memorial State Mon.	State	F & G	190	4			194		x				*
M	3,500	"	Aramoosh Fish Access Area	"	"	93				93		X				
H	5,000	"	Bighorn R. " " Area	"	"	78				78		x				
M	16,000	"	Two Leggins Fish Access Area	"	"	34				34		x				
H		"	Tongue River Reservoir	"	State	352			5,195	5,547		x				
		Carter	Nat'l Resource Lands	Federal	BLM	512,333				512,333			x			
M	9,350	"	Custer Nat'l Forest	Federal	USFS	89,377	23			89,400			X			
H	3,000	"	Medicine Rocks St. Pk.	State	F & G	300	20			320			x			
		Custer	Nat'l Resource Lands	Federal	BLM	341,475				341,475			x			
		"	Miles City Nat'l Fish Hatchery	"	USFWS	128			40	168		x				
		"	Brown Lake Fish Acc.	State	F & G	70				70		x				
I	1,500	"	Twelve Mile Dam Fish Access	"	"	44				44		x				
		"	Miles City Pond Site	"	State	30			40	70						
		Daniels	Nat'l Resource Lands	Federal	BLM	200				200			x			
I	2,000	"	Whitetail Reservoir	State	F & G	55	10			65		x				
		Dawson	Nat'l Resource Lands	Federal	BLM	67,090				67,090			x			
I	2,000	"	Intake Reservoir	State	F & G	30			38	68		x				
M	3,000	"	Intake Dam Fish Access Area	"	"	40				40		x				
L	2,000	"	Bellecher Pond Fish Acc.	"	"	24				24		x				
H	11,000	"	Makoshika St. Park	Fed- State	"	784				784			x			
		"	Shaffer Island Rec. Site	Federal	Federal	194				194						
		Fallon	National Resource Lands	Federal	BLM	121,906				121,906			X			

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STATE: MONTANA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Fallon	Baker (Sportsmens)pond Fish Access Area	Private	F & G	10				10		X				
		"	Rush Hall Reservoir Fish Access Area	State	"	25				25		X				
		Garfield	Nat'l Resource Lands	Federal	BLM	514,846				514,846			X			
		Garfield	Chas. M. Russell NWR	"	BSF&W	950,000				Ft.Peck Res 950,000					X	
		"	Ft. Peck Reservoir	"	C of E	1,000			212,000	213,000			X			
M	5,000	"	Hell Creek State Rec. Area (Nat'l Landmark)	"	F & G	63	50		Ft.Peck Res	113			X			
M	5,000	"	Rock Creek State Rec. Area	"	F & G	200	36		Ft. Peck Res	236			X			
		Golden Valley	Nat'l Resource Lands	"	BLM	1,475				1,475			X			
		"	Twin Coulee	"	"	6,800				6,800					X	
		"	Lewis & Clark Nat'l Forest	"	USFS	23,644				23,644			X			
		McCone	Nat'l Resource Lands	"	"	202,060				202,060			X			
		"	Lisk Creek Reservoir	State	Water Cons.Bd.				98	98			X			
		"	Rick Hall Reservoir	"	"				13	13			X			
		"	Tusler Creek Reservoir	"	"				68	68			X			
H		"	Bug Creek Fossil Area Nat'l Landmark	Fed-Private	BSF&W & Private	800				800				X		
		Musselshell	Nat'l Resource Lands	Federal	BLM	104,326				104,326			X			
		"	Melstone Reservoirs	"	"	30			10	40		X				
		"	Musselshell Site	"	"	160			(1 mi.)	160		X				
		"	Parrot Creek Site	"	"	160				160		X				
		"	Hwy. 12 Site	"	"	40				40		X				
		"	Lake Mason NWR	"	BSF&W	17,043			1,600	18,643					X	
		"	County State Forest	State	St.Forester	17,865				17,865			X			
		Powder River	Nat'l Resource Lands	Federal	BLM	257,836				257,836			X		X	
		"	Custer Nat'l Forest	"	USFS	341,933	13			341,946			X		X	
		Prairie	Nat'l Resource Lands	"	BLM	450,456				450,456			X			
		"	Clark Reservoir	"	BLM		2		50	52		X				
		"	Silver Tip Reservoir	"	"				10	10		X				
		"	South Fork Reservoir	"	"				30	30		X				
		"	Grant Reservoir	"	"				18	18		X				
		"	Terry Scenic View	"	"	120	3			123				X		

STATE: MONTANA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Prairie	Fallon Island Rec. Site	Federal	Federal	148				148						
		Richland	Nat'l Resource Lands	"	BLM	52,819				52,819			X			
L	1,000	"	Fox Lake Game Bird Management Area	State	F & G	350		1,012		1,362			X			
		"	Rohly Bridge Rec. Site	Federal	Federal	22				22		X				
M	6,000	"	Cartside Dam Fish Access	Private	F & G	10				10		X				
H		"	Ft. Union Trading Post NHS	Federal	NPS	47				47						X
		Roosevelt	Nat'l Resource Land	"	BLM	4,635				4,635			X			
M		"	Ft. Peck Indian Res.	Tribal	BIA	50	245	700	310	1,305			X			*
		"	Bainville State Resv.	State	Water Cons. Bd.				322	322			X			
		"	Big Muddy Dam	"	" "				1,540	1,540			X			
		"	Lewis & Clark Fort Sites	Private	Private	1,000				1,000						
		Rosebud	Nat'l Resource Lands	Federal	BLM	233,690				233,690			X			
M	2,300	"	Custer Nat'l Forest	"	USFS	95,826	1			95,827			X			
M		"	Northern Cheyenne Indian Reservation	Tribal	BIA	20	171		75	266		X				
M	23,000	"	Rosebud State Rec. Area	State	F & G	31				31		X				
		Sheridan	Nat'l Resource Lands	Federal	BLM	300				300			X			
		"	Medicine Lake NWR	"	BSF&W	19,597	30		11,831	31,458			X			
		Treasure	Nat'l Resource Lands	"	"	11,884				11,884			X			
M	2,000	"	Isaac Homestead Game Management Area	State	F & G	597				597			X			
		Valley	Nat'l Resource Lands	Federal	BLM	390,996				390,996			X			
H		"	Lurb Hill Rec. Lands	"	"	31,500				31,500			X			
		"	Badlands Rec. Lands	"	"	555,000				555,000			X			
		"	Seven Points Rec. Lands	"	"	48,500				48,500			X			
		"	Duck Creek	"	"	640				640			X			
		"	Timber Creek	"	"	640				640			X			
		"	Chas. M. Russell NWR	"	BSF&W	See Garfield County, Montana										
		"	Lewis & Clark Fort Sites	Private	Private	See Roosevelt County, Montana										

STATE: MONTANA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
L	16,000	Valley	Ft. Peck Dredge Pits	Federal	F & G	131	10			141		X				
		Wibaux	Nat'l Resource Lands	Federal	BLM	25,882				25,882			X			
		"	Lamesteer NWR	Private	BSF&W	690			110	800					X	
		"	Crane Island Rec.Site	Federal	Federal	83				83			X			
		Yellowstone	Nat'l Resource Lands	"	BLM	85,792				85,792			X			
L	2,000	"	Broadview Pond Fish Access	State	F & G	55				55		X				
H	25,000	"	Pictograph Caves St. Mon.	"	F&G	22				22			*			X
L	7,500	"	Laurel Pond Fish Acc.	"	"	15				15		X				
M		"	Pompey's Tower Game Management Area	Federal	"	94				94			X			
M		"	Black Bluff Game Management Area	"	"	52				52			X			
H		"	Yellowstone River Rec. Waterway	State	"							X				
		"	Bridle Moon Park	County	County	17				17		X				
		"	Coulson Park	"	"	73		20	5	98			X			
		"	Lockwood Park	"	"	10				10		X				
		"	McKenzie Park	"	"	10				10		X				
		"	Meadowlark Park	"		14				14		X				
		"	Sportsmans Park	"	"	10				10		X				
		"	West Park	"	"	30				30		X				
		"	Athletic Park	City	City	10				10		X				
		"	Central Heights Park Subdivision	"	"	10				10		X				
		"	Central Park	"	"	11				11		X				
		"	North Park	"	"	17				17		X				
		"	Optimist's Park	"	"	10				10		X				
		"	Pioneer Park	"	"	34				34		X				
		"	Rose Park	"	"	26				26		X				
		"	School Rec. Areas	"	"	3				3		X				
		"	Skyline Park	"	"	40				40		X				
		"	South Park	"	"	17				17		X				
		"	Stewart Park	"	"	60				60		X				

STATE: MONTANA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Yellowstone	Swords Park	City	City	128				128		X				
		"	Unnamed Scenic Park	"	"	60				60		X				
		"	Veterans Park	"	"	10				10		X				
H		"	Pompeys Pillar Nat'l Historic Landmark	Private	Private	40				40						X
			STATE TOTAL			5,684,672	1,804	1,732	240,496	5,928,704						

STATE: NORTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Adams	Nat'l Resource Land	Federal	BLM	80				80			X			
H	400	"	Dogtown Game Mgt. Ar.	State	G&F	37				37			X			
H	3,000	"	North Lemmon Lake GMA	"	"	44	5		60	109		X				
		"	Wolf Butte Dam	County	County	10			40	50			X			
		"	Reeder Park	City	City	2	2			4		X				
		"	Hettinger Park	"	"		6			6		X				
		"	Hettinger Rodeo Grnds.	"	"		4			4		X				
		"	Hettinger Pool	"	School Dist.		1			1	X					
		"	Hettinger Golf Course	Private	Private		80			80		X				
		"	Mirror Lake Dam	"	"	10			20	30			X			
		Billings	Nat'l Resource Lands	Federal	BLM	680				680			X			
	16,250	"	Little Missouri Nat'l Grassland	"	USFS	289,981	5			289,986			X			
H	1,009,600	"	Theo. Roosevelt Nat'l Memorial Park	"	NPS	45,858	152			46,010				*		X
H	57,000	"	DeMores Hist. Site	State	Historical	175	3			178						X
H	3,000	"	Sully's Creek St.Pk.	"	St. Pks.	40	40			80		X				
		"	Gold Seal Amphitheatre	Private	Private	4	4			8		X				
		"	Medora Trailer Camp	Private	"	285	35			320	X					
		"	Red Trail Camp	"	"		5			5		X				
		Bowman	Nat'l Resource Lands	Federal	BLM	32,808				32,808			X			
		"	Bowman-Haley Dam	"	"	2,688	12		1,700	4,400			X			
H	6,000	"	Ft. Dilts	State	Historical	8				8						X
H	4,103	"	Butte View	"	St. Pks.		22			22		X				
		"	Gascoyne Lake	County	County	240	10		170	420			X			
		"	Spring Lake	"	"	62			26	88			X			
		"	Bowman Co Fairgrounds	"	"		40			40		X				
		"	Bowman Park	City	City	5	8			13		X				
		"	Rhame Park	"	"		1			1	X					
		"	Scranton Park	"	"		3			3	X					
		"	Scranton Ball Field	"	School Dist.	15	5			20		X				
		"	Rhame Ball Field	"	"	3	2			5		X				
		"	SW Rod & Gun Club	Private	Private		3			3		X				
		"	Bowman Golf Course	"	"		90			90		X				
		Burleigh	Nat'l Resource Lands	Federal	BLM	732				732			X			

STATE: NORTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Burleigh	Canfield Lake NWR	Private	BSFAW	3		218		221					X	
		"	Florence Lake NWR	Federal	"	1,789		100		1,889					X	
L	500	"	Long Lake NWR	Fvt.-Fed.	"	8,605	5		13,700	22,310					X	
L	200	"	Arena GMA	State	G & F	800				800			X			
M	400	"	Bomber Lake GMA	"	"	161				161			X			
M	3,000	"	McKenzie Slough GMA	"	"	682				682			X			
M	400	"	Moffit GMA	"	"	160				160			X			
H	4,000	"	Oahe GMA	Federal	"	7,743			Shore of Oahe Res.	7,743			X			
H	2,000	"	Rice Lake GMA	State	"	976				976			X			
L	300	"	Wilton Mine GMA	"	"	196				196			X			
H	1,500	"	Chasha Hist. Site	"	Historical	1				1						X
H	10,000	"	Double Ditch	"	"	38				38						X
H	3,000	"	Menoken Indian Village Site	"	"	14				14						X
H	15,000	"	Camp Hancock	"	"		1			1						X
		"	General Sibley Park	Federal	City-Co.	53	80			133		X				
		"	Bismarck Parks	City	City	573	625			1,198		X				
		"	Wing Park	"	"		1			1	X					
		"	4-H Picnic Grounds	County	County		10			10		X				
		"	Sibley Girl Scout Camp	Federal	Private	11	1			12		X				
		"	KOA - Bismarck	Private	"	22	8			30	X					
		"	Bismarck Gun Club	"	"	42	10			52		X				
		"	Hughes Park	"	"	13	10			23		X				
		Dunn	Nat'l Resource Land	Federal	BLM	1,669				1,669			X			
L	2,500	"	Nat'l Resource Land	"	"	15,989				15,989			X			
		"	Lake Ilo NWR	"	BSFAW	2	5		400	407		X				
		"	Lake Sakakawea	"	C of E	109,338	3,423		370,300	483,061			X			
			Ft. Berthold Indian Reservation:													
		"	Bear Den	"	Tribal	35			Lake Sakakawea	35			X			
			Four Bears Park	"	"	100	36		"	136						
		"	Shell Creek	"	"	17			"	17						
		"	Twin Buttes	"	"	26			"	26						
		"	Skunk Creek	"	"	40			"	40						

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STATE: NORTH DAKOTA

Table 2 (Cont'd)

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Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
			Reservation: (Cont'd)													
		Dunn	Deep Waters	Federal	Federal	8	2		Lake Sakakawea	10						
		"	McKenzie Bay	"	"	40			"	40						
		"	Mossette Bay	Private	Private	38	2		"	40						
		"	Lost Bridge Rec.Area	Federal	C of E	8	2		"	10		X				
		"	Voight's Bay	"	"		125		"	125			X			
		"	Mosset Bay	"	"		20		"	20			X			
H	6,000	"	Little Mo. Bay St.Pk.	State	Park Serv.	5,940	60		"	6,000		X				
H	1,500	"	Killdeer Battlefield	"	Historical	1				1						X
		"	Watford Cty Campgrnd	Federal	City	10	40		"	50		X				
		"	Killdeer Park	City	"		1			1		X				
		"	Halliday Park	"	"	12	1			13		X				
		"	New Hradec Park	"	"		1			1		X				
		"	Killdeer Rodeo Grounds	Private	Private		15			15		X				
		Emmons	National Resource Lands	Federal	BLM	941				941			X			
L		"	Appert Lake NWR	Private	BSF&W	1,058		103	"	1,161					X	
L		"	Flickertail	"	"	579			61	640					X	
L		"	Springwater Lake NWR	"	"	624		16		640					X	
		"	Sunburst NWR	Fed-Private	BSF&W	295		33		328					X	
		"	Oahe Reservoir	Federal	C of E	170,417	2,610		313,800	486,827			X			
		"	Beaver Creek Rec. Ar.	"	"	80	100		Oahe Res.				X			
M	30,000	"	Oahe GMA	"	G & F	10,469			"	10,469			X			
		"	Rice Lake	County	County	50			1,350	1,400			X			
		"	Braddock Dam	"	"	35	5		120	160			X			
		"	Welk Dam	"	"	50			110	160			X			
		"	Nieuwama Dam	"	"	40			120	160			X			
		"	Hazelton Rec. Area	Federal	C of E	20	30		Oahe Res.	50		X				
		"	Hague Roadside Park	City	City		2			2		X				
		"	Linton Parks	"	"	20	22			42		X				
		"	Strasburg Park	"	"		2			2		X				
		"	Hazelton Park	"	"		5			5		X				
		"	Beaver Valley Rodeo Grounds	Private	Private		30			30		X				
		"	Linton Golf Course	"	"		60			60		X				
		Golden Valley	National Resource Lands	Federal	BLM	2,358				2,358			X			

STATE: NORTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
	4,550	Golden Valley	Little No. National Grassland	Federal	USFS	96,342				96,343			X			
M	10,000	"	Canal Hump GMA	State	G & F	37			75	112			X			
		"	Odland Dam	County	County	250			110	360			X			
		"	Golden Valley Fairgrounds	"	"	20	5			25		X				
		"	Beach Ballfield	City	SchoolDist.	15	10			25		X				
		"	Beach Park	"	City		16			16		X				
		"	Sentinel Butte Park	"	"	6	1			7		X				
		"	Golva Park	"	"		5			5		X				
		"	Beach Gun Club	Private	Private		2			2		X				
		"	Beach Golf Course	Private	"		30			30		X				
		Grant	Nat'l Resource Land	Federal	BLM		589			589			X			
	157,500	"	Lake Tschida	"	B/R	7,361			3,397	10,758			X			
		"	Pretty Rock MTR	Fed-Private	BSF&W	599			201	800					X	
		"	Cedar R. Nat'l Grassld	Federal	USFS	480				480			X			
M	40,000	"	Heart Butte GMA	"	G & F	215			Heart Butte	215			X			
H	500	"	Cannonball Stage Sta.	State	Historical	205				205						X
H	500	"	Medicine Rock Hist. Site	"	"	12				12						X
		"	Sheep Creek Dam	County	County	60	20		80	160			X			
		"	Raleigh Dam	"	"	5			15	20			X			
		"	Cat Coulee Dam	"	"	21			10	31			X			
		"	Carson Fairgrounds	"	"		40			40		X				
		"	Carson Park	City	City		4			4		X				
		"	New Leipzig Park	"	"	4	1			5		X				
		"	Elgin City Park	"	"		13			13		X				
		"	Boy Scout Camp	Federal	Private		5			5		X				
		"	Heart Butte													
		"	Farmers Union Camp	"	"	25				25			X			
		"	Heart Butte													
		"	Raleigh Rodeo Grounds	Private	"		4			4		X				
		"	Schlock Dam	"	"	1			5	6			X			
		"	Niederman Pond	"	"				1	1			X			
		"	Elgin Athletic Field	City	School Dist.		4			4		X				

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STATE: NORTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Hettinger	Mott Watershed Dam	County	County	45			35	80			X			
		"	Hettinger City Fair-grounds	"	"		40			40		X				
		"	New England Park	City	City	2	63			65		X				
		"	Regent Park	"	"		3			3		X				
		"	Mott Park	"	"	12	8			20		X				
		"	Regent Snowmobile Ar.	"	"		2			2			X			
		"	Harvey Pekes Dam	Private	Private	10			5	15			X			
		"	Edmund Kilzer Dam	Private	"	10			15	25			X			
		"	Lein Dam	"	"				10	10			X			
		"	Mott Golf Course	"	"		60			60		X				
		"	Larson Lake	"	"	20			60	80			X			
		"	Roeinmich Dam	"	"	17			23	40			X			
		"	New England Golf Club	"	"		10			10		X				
		Kidder	Nat'l Resource Land	Federal	BLM	1,520				1,520			X			
L		"	Hutchinson Lake NWR	Private	BSF&W	449		30		479				X		
		"	Lake George NWR	State	"	2,963			156	3,119				X		
		"	Slade NWR	Federal	"	2,133	20		847	3,000		X				
		"	Long Lake NWR	"	"	(See Burleigh Co, N. Dakota)										
H	1,000	"	Dawson GMA	State	G & F	2,951				2,951			X			
H	100	"	Frettim GMA	"	"	80				80			X			
M	500	"	Horsehead Lake GMA	"	"	437				437			X			
M	1,000	"	Lake Williams GMA	"	"	44				44			X			
L	50	"	Long Lake GMA	"	"	320				320			X			
M	1,000	"	Lake Williams	"	"	41	4		255	300			X			
M	500	"	Burmen Hist. Site	"	Historical	.01				.01						X
H	500	"	Camp Whitney	"	"	4				4						X
H	500	"	McPhails Butte Hist. Site	"	"	.33				.33						X
		"	Pettibone Park	City	City	6	2			8		X				
		"	Tappen Park	"	"		1			1		X				
		"	Tuttle Park	"	"		1			1		X				
		"	Clear Lake	State	G & F	6	4		40	50			X			
		"	Steele Park	City	City	28	75			103		X				
		"	Dawson Park	"	"		2			2		X				

STATE: NORTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Kidder	Lake Isabel	Private	County	145	5		100	250			X			
		"	Pettibone Golf Course	"	Private		40			40			X			
		"	Cherry Lake	"	"	14	6		200	220			X			
		"	Frettum Lake	"	"				70	70			X			
		"	Crystal Springs Lake	"	"		10		90	100		X				
		"	Persian Lake	"	"	10			90	100			X			
		"	Round Lake	"	"	25			275	300			X			
		McHenry	Nat'l Resource Lands	Federal	BLM	3,233				3,233			X			
		"	Souris Purchase Unit	"	USFS	160				160			X			
		"	Denbigh Purchase Unit	"	"	636				636			X			
		McKenzie	Nat'l Resource Lands	"	BLM	1,506				1,506			X			
		"	Little No. Nat'l Grassld	"	USFS	502,909	11		127	503,047			X			
		"	Theo. Roosevelt Nat'l Pen. Park	"	NPS	See Billings Co, N. Dakota										
		"	Lake Sakakawea	"	C of E	See Billings Co, N. Dakota										
		"	Antelope Creek GMA	"	G & F	813			Shore of Lake	813			X			
M	500	"	Tobacco Garden GMA	"	"	504			Sakakawea	504			X			
B	50	"	Overlook GMA	State	"	32				32			X			
H	2,000	"	Badlands State Park	"	Park Servl	1,500				1,500		X				
		"	Four Bears Rec. Complex	Tribal	Tribal	105	215		"	320			X			
		"	Bear Den	Federal	C of E	50			50	100			X			
		"	Yellowstone-Inubp Pk.	County	County		10			10		X				
		"	Tobacco Garden Rec.Ar.	Federal	"	70	30		Shore of	100		X				
		"	Armegard Dam	County	"	20	10		Lake Sakakawea 10	40		X				
		"	Grassy Butte Park	City	City		1			1		X				
		"	Alexander City Park	"	"		5			5		X				
		"	Arnegard Park	"	"		11			11		X				
		"	Watford City Parks	"	"		10			10		X				
		"	Watford City Golf Crse	Private	Private		160			160		X				
		"	Wackers Wheel Inn Cmpgrd	"	"		12			12		X				
		McLean	Nat'l Resource Lands	Federal	BLM	599				599			X			
		"	Audubon NWR	"	BSF&W	4,758			8,740	13,498				X		
		"	Camp Lake NWR	Private	"	1,009		216		1,225				X		
		"	Garrison Nat'l Fish Hatchery	Federal	"	55			35	90				X		

STATE: NORTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		McLean	Hiddenwood NWR	Private	BSF&W	456		92	20	568					X	
		"	Lake Nettie NWR	Federal	"	1,514			1,040	2,554					X	
		"	Lost Lake NWR	Private	BSF&W	899		61		960					X	
		"	McLean NWR	Fed - Private	"	690			70	760					X	
		"	Lake Sakakawea	Federal	C of E	See Dunn C., N. Dakota										
		"	Riverdale Park	Federal	"	2	5			7		X				
		"	Downstream Rec. Area	"	"		20			20		X				
		"	Fort Stevenson	"	"	423	15		Shore of Lake Sakakawea	438		X				
		"	Totten Trail Park	"	"	12	8			20		X				
M	50	"	Blue Lake GMA	State	G & F	5		8		13			X			
M	10,000	"	Deep Water Creek GMA	Federal	"	2,243			"	2,243			X			
L	500	"	Custer Mine GMA	State	"	476				476		X				
M	5,000	"	Garrabrland GMA	Federal	"	12,029			"	12,029			X			
M	1,000	"	Douglas Creek GMA	"	"	659			"	659			X			
H	10,000	"	Riverdale GMA	"	"	2,061				2,061			X			
H	25,000	"	L.Audubon GMA	"	"	5,148			"	5,148			X			
L	500	"	Wilton Mine GMA	State	"	106				106		X				
H	25,000	"	Wolf Creek GMA	Federal	"	4,180				4,180			X			
M	5,000	"	Crow Flies High	State	Pk Serv.	253				253		X				
H	500	"	Fort Mandan	"	Historical	30				30						X
		"	Lake Nettie	County	County	10			140	150			X			
		"	Lewis & Clark Historic Site	"	"	5	5			10						X
		"	Coulin Dam	"	"	20			62	82			X			
		"	Washburn Athletic Fld	City	School Dist		5			5		X				
		"	Washburn Park	"	City		10			10		X				
		"	Garrison Park	"	"		2			2		X				
		"	Underwood Park	"	"		1			1		X				
		"	Wilton Park	"	"	8	3			11		X				
		"	Turtle Lake Park	"	"	8	2			10		X				
		"	Butte Park	City	City		1			1		X				
		"	Garrison Bible Camp	Private	Private	20	5			25		X				
		"	Underwood Golf Course	"	"		60			60		X				
		"	Garrison Golf Course	"	"		60			60		X				

STATE: NORTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		McLean	Western 4-H Camp	Private	Private	7	80			87			X			
		"	Yanktonai Dam	"	"	40			40	80			X			
		"	Brush Lake	"	"	8	2		160	170			X			
		"	Crooked Lake	"	"	20			300	320			X			
		"	Strawberry Lake	"	"	160			100	260			X			
		"	Katz Dam	"	"				1	1			X			
		"	Lee's Resort	"	"		11			11		X				
		"	YMCA Camp-Garrison	"	"	290	30			320			X			
		"	Lutheran Bible Camp-Garrison	"	"	72	8			80		X				
		"	Riverdale Golf Course	Federal	"		60			60		X				
		"	Wolf Creek Rec. Area	"	"		4			4		X				
		Mercer	Nat'l Resource Lands	"	BLM	459				459			X			
		"	Lake Sakakawea	"	C of E	See Dunn Co., N. Dakota										
		"	Garrison Tailrace	"	"		2		No River	2			X			
L	1,000	"	Beaver Creek CMA	"	C & F	158	5		Shore of	163			X			
									Lake Sakakawea							
H	15,000	"	Hille CMA	"	"	761	163		"	924			X			
L	500	"	Beulah Mine CMA	State	"	1,174			Beulah Pond	1,174		X				
H	78,592	"	L. Sakakawea St. Pk.	Federal	St. Pks.	326	335			661		X				
H	100	"	Crowley Flint Quarry	State	Historical	2				2						X
H	3,000	"	Ft. Clark	"	"	198				198						X
		"	Hazen Rec. Area	Federal	City	58	2		Shore of	60			X			
									Lake Sakakawea							
		"	Beulah Bay Rec. Area	"	"	92	10		"	102			X			
		"	Zap Park	"	"	6	1			7		X				
		"	Beulah Parks	"	"		220			220		X				
		"	Hazen Parks	City	"	6	6			12		X				
		"	Stanton Park	"	"	7	5		Shore of Riv.	12		X				
		"	Camp Dominick Savio	Private	Private	88	10		Shore of	98			X			
									Lake Sakakawea							
		"	Hazen Golf Course	"	"		50			50		X				
		"	Hazen Horse Arena	"	"		25			25		X				
		"	Zap Shooting Range	"	"		10			10		X				
		"	Big Hidatsa Village NHL	"	"	200				200						X

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STATE: NORTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land Undeveloped	Land Developed	Water Marsh	Water Water	Total	Classification I	II	III	IV	V	VI
		Morton	Nat'l Resource Lands	Federal	BLM	252				252			X			
M	4,000	"	Green Butte GMA	State	G & F	40			44	84			X			
M	500	"	Fish Creek GMA	"	"	133			57	190		X				
L	500	"	Glen Ullin GMA	"	"	200			30	230			X			
H	200	"	Lake Patricia GMA	"	"	631				631			X			
H	1,000	"	Morton Co. GMA	"	"	640				640			X			
L	1,000	"	Storm Creek GMA	"	"	380			100	480		X				
M	18,000	"	Southwicker Lake GMA	"	"	563	5		320	888		X				
H	40,100	"	Cube GMA	Federal	"	5,737			Shore of Lake Cube	5,737			X			
H	74,349	"	Ft. Lincoln St.Park	State	Park Serv.	721	59			809		X				
H	1,000	"	Deadwood Stage Marker	"	Historical	.06				.06						X
H	3,000	"	Fort Rice	"	"	7				7						X
H	2,000	"	Huff Indian Village	"	"	14				14						X
		"	Hebron Park	City	City	6	5			11		X				
		"	Glen Ullin Park	"	"	12	8			20		X				
		"	Almont Park	"	"		1			1		X				
		"	New Salem Park	"	"		166			166		X				
		"	New Salem Rodeo Grnds	"	"		10			10		X				
		"	Flasher Park	"	"	5	4			9		X				
		"	Mandan Parks	"	"	75	125			200		X				
		"	Morton Dam	Private	Private	9			8	17			X			
		"	Glen Ullin Rodeo Grnds	"	"		5			5		X				
		"	Anderson Marina	"	"		2		Shore of No. River	2		X				
		"	Richor Marina	"	"		2		"	2						
		Mountrail	Nat'l Resource Lands	Federal	BLM	1,309				1,309			X			
L	1,600	"	Lostwood NWR	"	BSFW	24,810			1,938	26,748					X	
		"	Shell Lake NWR	Fed - Private	"	1,303			532	1,835					X	
		"	Lake Sakakawea	Federal	C of E	See Dunn Co., N. Dakota										
M	20,000	"	Van Hook Arm GMA	"	G & F		282	77	Shore of L. Sakakawea	359			X			
M	50	"	Palermo GMA	State	"	5		35		40			X			
M	400	"	White Earth Valley GMA	"	"	275			5	280			X			
		"	Parshell Bay	Federal	C of E	51	4		Shore of L. Sakakawea	55			X			

STATE: NORTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Mountrail	Clear Lake Rec. Area	County	County	3	20		20	43		X				
		"	VanHook Rec. Area	Federal	"		12		Shore of L. Sakakawea	12		X				
		"	4-H Fairgrounds-Stanl[illegible]	County	"		30			30		X				
		"	Stanley Athletic Field	City	School Dist.		6			6		X				
		"	Paulson Dam	State	?	40			12	52			X			
		"	Parshell Dam	"	City	15			4	19			X			
		"	Plaza Park	City	"		3			3		X				
		"	Parshell Park	"	"	24	25			49		X				
		"	Stanley Park	"	"	8	20			28		X				
		"	New Town Park	"	"		2			2		X				
		"	Sikes Dam	Private	Private	200			640	840			X			
		"	Stanley Golf	"	"		100			100		X				
		"	White Earth Rodeo Grnds	"	"		160			160		X				
		"	Boy Scout Camp	"	"	98	52		150	300			X			
		"	New Town Rodeo Grnds.	"	"		4			4		X				
		"	Parshell Golf Course	"	"		80			80		X				
		"	Blaisdell Rodeo Grnds.	"	"		5			5		X				
		"	Plaza Archery Range	"	"		3			3			X			
		Oliver	Nat'l Resource Lands	Federal	BLM	274				274			X			
M	100	"	Arrowa Lake GMA	State	G & F	384				384			X			
H	2,000	"	Lewis & Clark GMA	"	"	121				121			X			
H	400	"	Smith Grove GMA	"	"	24				24				X		
H	500	"	Heland[illegible] Indian Villa[illegible]	"	Historical	12				12						X
		"	Center Ball Field	City	School Dist.	4	4			8		X				
		"	Center Park	"	City	7	3			10		X				
		"	Nelson Lake	Private	Private	10	5		400	415			X			
		"	Van Coating Dam	"	"	54	1		25	80			X			
		"	Tony Neshrucker Dam	"	"	2			10	12			X			
		"	Moon Dam	"	"	2			2	4			X			
		"	Hagerott Dam	"	"	2			2	4			X			
		"	Keller Dam	"	"	4			12	16			X			
		"	Zahn Dam	"	"	8			2	10			X			
		"	Olander Dam	"	"		4		10	14			X			
		"	Price Dam	"	"	2			4	6			X			

STATE: NORTH DAKOTA

Table 2 (Cont'd)

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Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Oliver	Gullickson Dam	Private	Private	2			5	7			X			
		"	Marcus Moshrucker Dam	"	"	4			12	16			X			
		"	Bubel Rodeo Arena	"	"		5			5		X				
		Pierce	Nat'l Resource Lands	Federal	BLM	126				126			X			
		Renville	"	"	"	78				78			X			
		"	Upper Souris NWR	"	BSF&W	3,680			240	3,920					X	
		Sheridan	Nat'l Resource Lands	"	BLM	378				378			X			
		"	Sheyenne Lake NWR	Fed - Private	BSF&W	619			178	797					X	
		"	Martin Park	City	City	3	2			5		X				
		"	Goodrich Park	"	"		5			5		X				
		"	McCluskey Park	"	"	4	8			12		X				
		"	McCluskey Ball Field	"	School Dist.		6			6		X				
		"	Sellon Memorial	Private	Private	200				200						X
		"	Harvey Dam	"	"	2			8	10			X			
		"	Ponderosa Horse Club	"	"	5	1			6		X				
	1,000	Sioux	Cedar River Nat'l Grassland	Federal	USFS	6,237				6,237			X			
		"	Oahe Reservoir	"	C of E	See Emmons Co., N. Dakota										
		"	Ft. Yates Boat Ramp	"	"		1			1		X				
		"	Ft. Yates Park	Tribal	Tribal		10			10		X				
		"	Long Soldier Coulee Rec. Area	"	"		60			60		X				
		"	Bill Golf Course	"	"		60			60		X				
M	2,000	"	Fromlich Park GMA	State	G & F	243	3		50	296			X			
		"	Wood Dam	"	"	8			22	30			X			
	3,000	"	Sitting Bull Hist. Site	"	Historical		5			5						X
		"	Solen Park	City	City		3			3		X				
		"	Fatt Dam	Private	Private	5			15	20			X			
L		Slope	Stewart Lake NWR	Fed-Private	BSF&W	2,033			197	2,230					X	
L		"	White Lake NWR	Federal	"	860			180	1,040					X	
	22,300	"	Little No. Nat'l Grassland	"	USFS	138,315	42			138,357			X			
M	2,000	"	Cedar Lake GMA	State	G & F	658			160	818			X			
H	1,500	"	Speck Davis GMA	"	"	160				160			X			
		"	Marmarth Park	City	City		6			6		X				

STATE: NORTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Slope	Amidon Park	City	City	3	1			4		X				
		"	Slope Farmers Rodeo Grounds	Private	Private		40			40		X				
		"	Davis Dam	"	"	10			30	40			X			
		"	Hamana Dam	"	"	10			30	40			X			
H	500	Stark	Sully Corral	State	Historical	5				5						X
		"	Belfield Ball Field	City	School Dist.		5			5		X				
		"	Dickinson St. College Amphitheatre	State	College		2			2		X				
		"	Patterson Lake	Federal	Priv-Cty-S/R	2,197	60		800	3,057			X			
		"	Belfield Rec. Area	City	City		7		3	10		X				
		"	Dickinson Dike	"	"	2			18	20			X			
		"	Belfield Park	"	"		4			4		X				
		"	Richardton Park	"	"	5	22			27		X				
		"	Dickinson Parks	"	"	30	90			120		X				
		"	Abley Dam	Private	Private	10			70	80			X			
		"	Schnell Rodeo Grnds.	Private	"		40			40		X				
		"	Dickinson Gun Club	"	"		20			20		X				
		"	Lion's Park-Dickinson	"	"		10			10		X				
		"	KOA - Dickinson	"	"	3	17			20		X				
		"	Kiwa Campgrnd-Dickinson	"	"		40			40		X				
		"	Green River Picnic Area	"	"		5			5		X				
		"	KYOBA Campgrnd-Dickinson	"	"		20			20		X				
		Ward	Nat'l Resource Lands	Federal	BLM	266				266			X			
M	50	"	Foxhole GMA	State	G & F	40				40			X			
		"	Old Settlers Park	County	County	30	10		10	50		X				
		"	Nelson-Carlson Lake	"	"	20			80	100			X			
		"	Rice Lake	"	"	30			50	80			X			
		"	Mabott Park	City	City		5			5		X				
		"	Surrey Park	"	"		2			2		X				
		"	Sawyer Park	"	"		5			5		X				
		"	Berthold Park	"	"		3			3		X				
		"	Carbio Park	"	"		5			5		X				
		"	Kenmare Park	City	City		10			10		X				
		"	Kenmare Golf Course	"	"		50			50		X				

STATE: NORTH DAKOTA

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Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Ward	Des Lacs Ball Field	City	City		2			2		X				
		"	Donnybrook Park	"	"	7	3			10		X				
		"	Minot Parks	"	"	75	250			325		X				
		"	Des Lacs Railroad Dam	"	"	3	2		50	55			X			
		"	Minot St. College Pool	State	College		1			1	X					
		"	KOA - Minot	Private	Private		9			9		X				
		"	Casa Cmpgrnd- Minot	"	"		5			5		X				
		"	Boy Scout Camp-Minot	"	"		15			15		X				
		"	Minot Gun Club	"	"		10			10		X				
		"	Velva Sportsmans Club	"	"	10			20	30			X			
		"	Minot Archery Club	"	"		20			20		X				
		Williams	Nat'l Resource Lands	Federal	BLM	1,303				1,303			X			
		"	Lake Zahl NWR	Fed-Private	FSF&W	2,523			1,300	3,823					X	X
		"	Lake Sakakawea	Federal	C of E	See Dunn Co., N. Dakota										
H	900D	"	Ft. Union Trading Post NHS	"	NPS	192	3			195						X
		"	Lewis & Clark Bay	"	C of E	607	3		30	640			X			
		"	Kota Ray Dam	County	County	28	2		40	70			X			
		"	Epping Springbrook Dam	"	"	45	5		80	130			X			
		"	Trenton Lake	Federal	"	37	3		80	120			X			
		"	Blacktail Dam	County	"				125	125			X			
M	1,000	"	Blacktail Dam GMA	State	G & F	36	10			46		X				
M	200	"	Blue Ridge GMA	"	"	18		70	80	168			X			
M	2,000	"	McGregor Dam GMA	"	"	125			66	191		X				
M	4,000	"	Hofflund GMA	Federal	"	745			Shore of L. Sakakawea	745			X			
H	10,000	"	Ft. Buford Hist. Site	State	Hist. Soc.	196	3			199						X
		"	Williston Rec. Parks	City	City	108	65		25	198		X				
		"	Ray City Park	"	"		5			5		X				
		"	Tioga Parks	"	"	44	10		165	219		X				
		"	Grenora Park	"	"		3			3		X				
		"	Wildrose Park	"	"		3			3		X				
		"	Lake Jessie	Private	Private	10			40	50			X			
		"	Driftwood Cmpgrnd.	"	"		10			10		X				
		"	KOA - Williston	"	"		10			10		X				

STATE: NORTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land		Water		Total	Classification					
						Undeveloped	Developed	Marsh	Water		I	II	III	IV	V	VI
		Williams	Cottonwood Lake	Private	Private	38	2		45	85			X			
		"	Upper Mo. Lutheran Bible Camp	"	"	39	1		60	100			X			
		"	Red Barn TrailerCrt.	"	"		8			8		X				
		"	Tioga Golf Course	"	"		40			40		X				
		"	Williston Golf Course	"	"		160			160		X				
		"	Elks Golf Course - Williston	"	"		140			140		X				
			STATE TOTAL			1,587,827.40	12,819	1,059	727,728	2,329,433.40						

STATE: SOUTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Butte	Belle Fourche Res.	Federal	B/R	6,550	100		8,074	14,754			X			
		"	Nat'l Resource Lands	"	BLM	145,891				145,891			X			
M		"	Newell Lake	State	GF&P	571	1		228	800			X			
	850	Corson	Grand River Nat'lGrass-land	Federal	USFS	31,105				31,105			X			
		"	Oahe Reservoir	"	C of E	See Emmons	County, N.	Dakota								
		"	Indian Island Mem.Pk.	"	BIA	490	10			500		*	X			*
		Dewey	Cheyenne River Reservations	"	"								X			
		"	Claymore Church	"	"	1			Oahe Res.	1						X
		"	Monument of Chiefs	"	"	1			"	1						X
		"	Cheyenne River	"	C of E	360			"	360			X			
		"	Forest City	"	"	100	20		"	120		*	X			
		"	Moreau River	"	"	300			"	300			X			
		"	No Heart	"	"	40			"	40			X			
		"	Rousseau	"	"	160			"	160			X			
		"	Oahe Reservoir	Federal	"	See Emmons	County, N.	Dakota								
H	9,139	"	Little Moreau Rec. Area	State	GF&P	255	35		30	320		*	X			
M		"	Isabel Lake Access	"	"	609	1		30	640			X			
M		"	Firesteel Lake Access	"	"	74	1		5	80			X			
M		"	Little Moreau Game Production Area	"	"	2,953	1		50	3004			X			
H		"	Molstad Village	State	State	10				10						X
		Harding	National Resource Land	Federal	BLM	29,880				29,880			X			
	5,650	"	Custer Nat'l Forest	"	USFS	73,443	43		3	73,489			X			
M		"	Buffalo Lake Access	State	GF&P	92	1		220	313			X			
		Meade	National Resource Land	Federal	BLM	29,405				29,405			X			
H		"	Ft. Meade Complex	"	"	5,993	7		2	6,002	X					
		"	Bear Butte NWR	"	BSF&W	649	40		268	957			X			
		"	Black Hills Natl For.	"	USFS	36,738	6		41	36,785			X			
H	46,403	"	Bear Butte State Park Nat'l Landmark	State	GF&P	1,645	25			1,670		*	X	*		
M		"	Curlew Lake Access	"	"	299	1		140	440			X			
M		"	Tisdale Dam Access	"	"	139	1		20	160			X			

STATE: SOUTH DAKOTA

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
M		Meade	Opal Lake Access	State	GF&P	171	1		28	200			X			
M		"	Narcotte Game Production Area	"	"	583	1			584			X			
M		"	Bear Butte Lake Game Production Area	"	"	78	1		138	217			X			
		Perkins	Nat'l Resource Lands	Federal	BLM	9,227				9,227			X			
	3,800	"	Grand River National Grassland	"	USFS	122,155			211	122,366			X			
M	24,533	"	Llewellyn Johns Mem. Fee. Area	State	GF&P		69		45	114		X				
M		"	Bison Lake Access	"	"	106	1		149	256			X			
M		"	Lemon Lake Access	"	"	122	1		157	280			X			
M		"	Scrum Lake Game Production Area	"	"	214	1		105	320			X			
M		"	Lebeida Refuge	"	"	92	1		30	123			X			
M	87,950	"	Shadehill Reservoir	Federal	"	2,000	150			2,150		*	X			
		Tiebach	Grand River National Grassland	"	USFS	118				118			X			
M		"	Dupree Lake Access	State	GF&P	119	1		40	160			X			
			STATE TOTAL			502,773	520		10,014	513,307						

STATE: WYOMING

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land Undeveloped	Land Developed	Water Marsh	Water Water	Total	Classification I	II	III	IV	V	VI
		Campbell	Nat'l Resource Lands	Federal	BLM	223,318				223,318			X			
	5,900	"	Thunder Basin Nat'l Grassland	"	USFS	157,600			405	158,005			X			
		"	Edwards Res. Public Fish Area	State	State	58				58			X			
		"	Gillette St. Wildlife Area	"	"	18			40	58			X			
		"	Dalby New Pk & Lake	County	County		60			60		X				
		"	Gillette City Park	City	City		10			10		X				
		Converse	Nat'l Resource Land	Federal	BLM	128,866				128,866			X			
M	4,500	"	Thunder Basin NG	"	USFS	185,513			195	185,708		•	X			
	13,150	"	Medicine Bow NF	"	"	78,797	4		470	79,271			X			
M	10,000	"	Fort Fetterman	State	Wyoming Park Comm	60				60	•			X		
		"	Ayer Park (Nat. Bridge)	County	County	20				20				X		
		"	Boulder Co. Park	"	"		2			2		X				
		"	Douglas Riverside Pk	City	City		3			3		X				
		"	Douglas Wash. Park	"	"		9			9		X				
		"	Clearrock City Pk	"	"		10			10		X				
		Crook	Nat'l Resource Lands	Federal	BLM	101,025				101,025			X			
M	50	"	Thunder Basin NG	"	USFS	302				302		•	X			
	66,200	"	Black Hills Nat'l For.	"	"	163,874	8		342	164,224			X			
H	150,916	"	Devils Tower NM	"	NPS	1,326	21			1,347				X		
		"	Keyhole Reservoir	"	B/R	6,770			9,394	16,134			X			
H	91,516	"	Keyhole Res. Rec Area	"	Wy. Rec. Comm	6,700			Keyhole Res	6,700	X					
		"	Sand Creek	State	G & F	20				20			X			
		"	Moorcroft Campground	City	City		2			2		X				
		"	Moorcroft Roonan Picnic Ground	"	"		1			1		X				
		"	Sundance Picnic Grnd	"	"		2			2		X				
		Johnson	Nat'l Resource Lands	Federal	BLM	202,084				202,084			X			
L	3,000	"	Cloud Creek Rec. Complex	"	"	141,255				141,255			X			
H	7,000	"	Hole-in-the-Wall Rec. Complex	"	BLM	195,070				195,070			X			
H	141,350	"	Bighorn Nat'l For.	"	USFS	327,909	201		3,491	331,601		•	X		•	

STATE: WYOMING

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Johnson	Ft. Phil Kearny NHL	State	Wyo. Rec. Comm		3			3						X
		"	Ft. Feno Hist. Site	"	"		14			14						X
		"	Buffalo City Park	City	City	8				8		X				
		"	Buffalo Municipal Campground	"	"		6			6		X				
		"	Cold Springs Cmpgrnd.	"	"	20				20			X			
		"	Cold Springs Picnic Ground	"	"	20				20			X			
		Natrona	Nat'l Resource Lands	Federal	BLM	1,369,156				1,369,156			X			
H	6,000	"	Muddy Mtn. Rec. Lands	"	"	1,260				1,260		*		X		
H	26,500	"	Trapper Rte. Canoe Trail (N. Platte R.)	"	"	3,264			(50 mi.)	3,264				X		X
	5,000	"	Pathfinder MWR	"	BOR	12,644	10			12,654					X	
	1,800	"	Medicine Bow NF	"	USFS	5,445			90	5,535			X			
		"	Evansville St. Rec.Ar.	State	G & FC	105	5			110			X			
M	30,000	"	Independence Rock SHL	"	Wyoming Rec Comm	955	5			960		*		*		X
H	369,275	"	Alcova Res. Cmpgrnd.	Federal	Co.Pk.Bd.	3,237			2,500	5,737			X			
		"	Archery Range	County	"	112				112			X			
		"	Bertrap Meadow Park	"	"	160				160			X			
		"	Casper Mtn. Pk.	"	"	480				480		*	X			
	14,580	"	Gray Reef Res.	Federal	"	43			181	224		X				
	60,368	"	Pathfinder Res.	"	"	26,417			15,528	41,945			X			
		"	Rotary Park	County	"		59			59		X				
		"	Casper Adams Park	City	City		2			2		X				
		"	Casper City Park	"	"		4			4		X				
		"	Conwell Park (Casper)	"	"		2			2		X				
		"	Casper Lantdale Park	"	"		4			4		X				
		"	Casper "I" St. Park	"	"		2			2		X				
		"	Casper Huber Park	"	"		6			6		X				
		"	Casper Manor Hgts. Pk.	"	"		3			3		X				
		"	" Marion Criner Pk	"	"		1			1		X				
		"	" Mike Sedar Park	"	"	65				65			X			
		"	" Nancy English Pk	"	"		15			15		X				
		"	" Randalette Pk.	"	"		1			1		X				

STATE: WYOMING

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Natrona	Casper River View Pk	City	City		2			2		X				
		"	" So. Ridge Pk.	"	"		2			2		X				
		"	" Veterans Pk.	"	"		1			1		X				
		"	" Washington Pk.	"	"		26			26		X				
		"	" Westwood Pk.	"	"		3			3		X				
		"	" Yeiness Pk.	"	"		7			7		X				
		"	Evansville Park	"	"		1			1		X				
		"	Fort Casper	"	"		30			30						X
		"	North Casper Park	"	"	93				93		X				
		"	Camp Wyoming R.A.	Private	Private	10				10		X				
		"	Sun (Tom) Ranch Mil.	"	"	960				960						X
		Niobrara	Nat'l Resource Lands	Federal	BLM	159,704				159,704			X			
H		"	Lance Creek Fossil Area NNL	Fed-St-Pvt.	BLM-State	368,640(approx)				368,640(approx)				X		
	100	"	Thunder Basin NG	Federal	USFS	840				840			X			
		"	Luck Rest Area	State	Hwy. Dept.		15			15		X				
		"	North Side Ground.	City	City		1			1		X				
		"	Northside Picnic Grnd	"	"		1			1		X				
		"	Luck Was. Mem. Park	"	"		1			1		X				
		Sheridan	Nat'l Resource Lands	Federal	BLM	50,668				50,668			X			
H	198,600	"	Bighorn Nat'l Forest	"	USFS	399,697	340		2,312	402,349		*	X			
M	6,000	"	Connor Battlefield Hist. Site	State	Wyoming Eco. Com.		1.2			1.2						X
		"	Tongue R. Pub. Fish Ap.	"	G & F	270			26	296			X			
		"	Arsden Crk. St. W. Ref.	"	G & F	2,589			1	2,590			X			
		"	Ketna St. Wildlife Ref.	"	"	5,142				5,142			X			
		"	Sheridan Bird Farm	Local	"	47				47			X			
		"	Sheridan Co. St. Wild. Life Refuge	"	"	7,731				7,731			X			
		"	Sheridan Info Ctr.	State	Hwy. Dept.		25			25		X				
		"	Sheridan Kendrick Pk	City	City		12			12		X				
		"	Sheridan Wash. Park	"	"		1			1		X				
H		"	Sheridan Ina NNL	Private	Private		10			10						X

STATE: WYOMING

Table 2 (Cont'd)

Quality	Annual Visits	County	Area Name	Ownership	Admin.	Land: Undeveloped	Land: Developed	Water: Marsh	Water: Water	Total	Classification: I	II	III	IV	V	VI
		Weston	Nat'l Resource Lands	Federal	BLM	78,684				78,684			X			
	5,350	"	Thunder Basin NG	"	USFS	226,940			505	227,445			X			
	1,600	"	Black Hills Nat'lFor.	"	"	6,364				6,364			X			
		"	Mallo Campground	County	County	153				153		X				
		"	Newcastle Dow Park	City	City		2			2		X				
		"	Upton City Cmpgrnd.	"	"	25				25		X				
			STATE TOTAL			4,654,503	956.20		35,480	4,690,939.20						

Discussion Draft
February 1974

AGRICULTURE

I. INTRODUCTION

Agriculture undergirds the economy of the NGPRP study area, and the two principal staple products are "wheat and meat." Most agricultural production results from dryland farming and ranching operations, but a small percentage (2.95) of the land is irrigated.

The livestock population consists chiefly of cattle, sheep, and hogs. The principal agricultural crops are wheat, barley, flax, rye, oats, corn, alfalfa, and sugar beets. Other crops occupying small acreages include potatoes, soybeans, sorghum, rice, peanuts, peas, beans, and sugarcane. Poultry, eggs, and dairy products are an important agricultural production in some localities.

The total land area within the 63 counties of those portions of Montana, North and South Dakota, and Wyoming that comprises the NGPRP study area is 89,916,011 acres, of which 23,508,740 acres are classified as cropland. Of this total, 97.05 percent is nonirrigated. Of the total land area, 62,542,666 acres, or 69.6 percent, is in pasture or rangeland.

There are 37,920 farms in the study area. They vary tremendously in average size, from the smallest averaging 815 acres in Ward County, North Dakota, to the largest averaging 11,105 acres in Natrona County, Wyoming.

II. PROCEDURES

Data for tables contained in this report were obtained from the USDA Crop and Livestock Reporting Service in each of the four States within the NGPRP study area. Table 1 was provided by Frank J. Osterhoudt, Economic Research Service, USDA, Washington, D.C. The Agricultural Land Use tables and Figures 1, 2, and 3 were provided by James M. Binando, Acting Chief, Planning Coordination Staff, BLM, Billings, Montana. Data for these tables were derived from the U.S. Census of Agriculture, 1969, U.S. Bureau of the Census, 1970, as modified by State Conservation needs inventory, and from published and unpublished data from other Federal agencies.

III. RESULTS

Throughout this discussion, the reader should bear in mind that the area of consideration relates to 63 counties previously enumerated which comprise portions of four States. Within the Northern Great Plains Resources Program study area, there are 37,920 farms (Table 1). They vary greatly in size, depending largely upon the intensiveness of the particular agricultural pursuits. The average size by States is: Montana--3,771 acres; North Dakota--1,294 acres; South Dakota--3,598 acres; and Wyoming--6,329 acres.

As of January 1, 1972, nearly 3.75 million head of cattle and calves stocked the farms and ranches (Table 2); sheep and lambs numbered almost 2 million, and hogs and pigs totaled slightly more than 300,000.

Crop production for 1971 is shown in Table 3. In 1971, slightly more than 130 million bushels of wheat were produced on about 6.5 million acres--the average yield was 20 bushels per acre. Barley production the same year was 32.6 million bushels on 881,400 acres for an average yield of 37 bushels per acre. Flax production is limited chiefly to the counties of North Dakota, where the average yield of flaxseed is 9.6 bushels per acre.

Rye is produced in all States except the northern counties of Wyoming, but most of it grows in North Dakota. In 1971, the average yield per acre was about 30 bushels. Oats were grown in all States in 1971, but 80 percent of the production was in North Dakota, where the yield was about 50 bushels per acre. Corn and alfalfa

Northern Great Plains Resources Program
Surface Resources Work Group

Draft 4
February 1974

Table 1.--Number of farms and average size of farm (acres) in 1969 Northern Great Plains Resources Program study area

Montana

County	No. Farms	Average Size (Acres)
Big Horn	540	5,216.6
Carter	374	4,134.7
Custer	386	5,957.1
Daniels	466	1,803.4
Dawson	552	2,548.0
Fallon	321	2,993.0
Garfield	294	8,002.6
Golden Valley	154	4,745.7
McCone	510	2,805.8
Musselshell	228	5,021.6
Powder River	364	4,655.3
Prairie	229	2,860.4
Richland	720	1,740.9
Roosevelt	715	2,002.4
Rosebud	390	7,597.5
Sheridan	734	1,490.9
Treasure	121	5,261.4
Valley	720	2,697.8
Wibaux	211	2,476.5
Yellowstone	1,139	1,415.3
Subtotal	9,168	-

North Dakota

Adams	498	1,280.7
Billings	292	2,688.5
Bottineau	1,277	838.3
Bowman	418	1,788.5
Burke	739	893.2
Burleigh	932	1,099.7
Divide	733	1,072.4
Dunn	821	1,756.2
Emmons	1,055	860.3
Golden Valley	305	1,710.2
Grant	872	1,164.9
Hettinger	663	1,182.9
Kidder	674	1,471.1
McHenry	1,211	934.2
McKenzie	905	1,875.7
McLean	1,439	874.8
Mercer	706	899.3

Table 1 (Cont'd)

North Dakota		
County	No. Farms	Average Size (Acres)
Morton	1,146	1,030.1
Mountrail	1,112	1,015.4
Oliver	434	1,046.2
Pierce	778	870.0
Renville	616	861.1
Sheridan	654	916.8
Sioux	239	2,977.7
Slope	324	2,240.1
Stark	909	947.4
Ward	1,555	815.1
Williams	1,153	1,114.6
Subtotal	22,460	-
South Dakota		
Butte	508	2,833.8
Corson	510	2,930.7
Dewey	373	4,051.7
Harding	332	4,785.9
Meade	800	2,631.0
Perkins	651	2,652.5
Ziebach	228	5,300.7
Subtotal	3,402	-
Wyoming		
Campbell	479	6,408.2
Converse	314	8,145.3
Crook	484	3,195.7
Johnson	273	7,803.2
Natrona	269	11,105.3
Niobrara	328	4,692.4
Sheridan	497	3,035.9
Weston	246	6,323.4
Subtotal	2,890	-
Region Total	37,920	-

Source:

U. S. Census of Agriculture, 1969, Volume 1, Section 2, County Data, Table 1.
Provided by Frank H. Osterhoudt, ERS,USDA

Table 2.--Livestock on farms in 1972, collectively by counties in the states in the NGPRP study area

NGPRP counties in	All cattle and calves Jan. 1, 1972	All sheep and lambs Jan. 1, 1972	Hogs and pigs Dec. 1, 1971
Montana	1,252,000	480,200	79,000
No. Dakota	1,417,000	145,100	147,500
So. Dakota	491,000	436,600	64,950
Wyoming	569,300	791,300	11,270

Table 3.--Crop production by collective counties by states in Northern Great Plains Resources Program study area in 1971

NGPRP counties in	All wheat		Barley		Flax		Rye	
	Harvested acres	Production bushels	Harvested acres	Production bushels	Harvested acres	Production bushels	Harvested acres	Production bushels
Montana	1,798,600	45,166,700	354,500	12,157,100	6,900	56,000	4,600	101,600
No. Dakota	4,294,700	73,640,100	467,000	18,189,200	310,000	2,990,250	112,000	3,385,000
So. Dakota	367,140	9,972,750	31,900	1,244,300	10,600	93,500	6,880	212,800
Wyoming	60,900	1,836,100	28,000	1,033,200				

	Oats		Sugar beets		Corn	Alfalfa hay
	Harvested acres	Production bushels	Harvested acres	Production T/acre	Acres planted	Harvested acres
Montana	109,300	4,449,400	34,090	143.5	60,100	340,300
No. Dakota	908,000	45,062,000	7,760	70.9	229,100	809,000
So. Dakota	121,100	5,803,500			63,000	412,500
Wyoming	23,700	1,002,300	810	14.1	8,700	180,300

are grown in all States--again acreages in North Dakota outdistancing those in other States by wide margins.

Sugar beets are grown only in Montana, North Dakota, and Wyoming, the latter two States supporting relatively small acreages.

Additional information regarding numbers of farms, average size, crop production, livestock production by States and counties, and agricultural land use statistics is contained in Tables 1-6.

Cropland as a percent of total land area by counties is shown graphically in Figure 1. Comparing data as depicted for 1970 with other available data for 1964, only 10 of the 63 counties have shown changes that result in their being placed in different percentage classes of cropland since 1964. McCone County, Montana; Burleigh, Hettinger, McKenzie, Mercer, and Ward Counties, North Dakota; Meade County, South Dakota; and Niobrara County, Wyoming, have shown slight increases in acreages of cropland. Two counties--Kidder, North Dakota, and Dewey, South Dakota--have experienced slight decreases in cropland acreages since 1964.

Overall, the breakdown according to the three major land uses by States is:

States	Counties	Cropland (Percent)	Pasture and Rangeland (Percent)	Forest and Woodland (Percent)
Montana	20	18.4	77.5	4.1
North Dakota	28	56.9	40.4	2.7
South Dakota	7	15.8	83.0	1.2
Wyoming	8	3.8	87.4	8.8

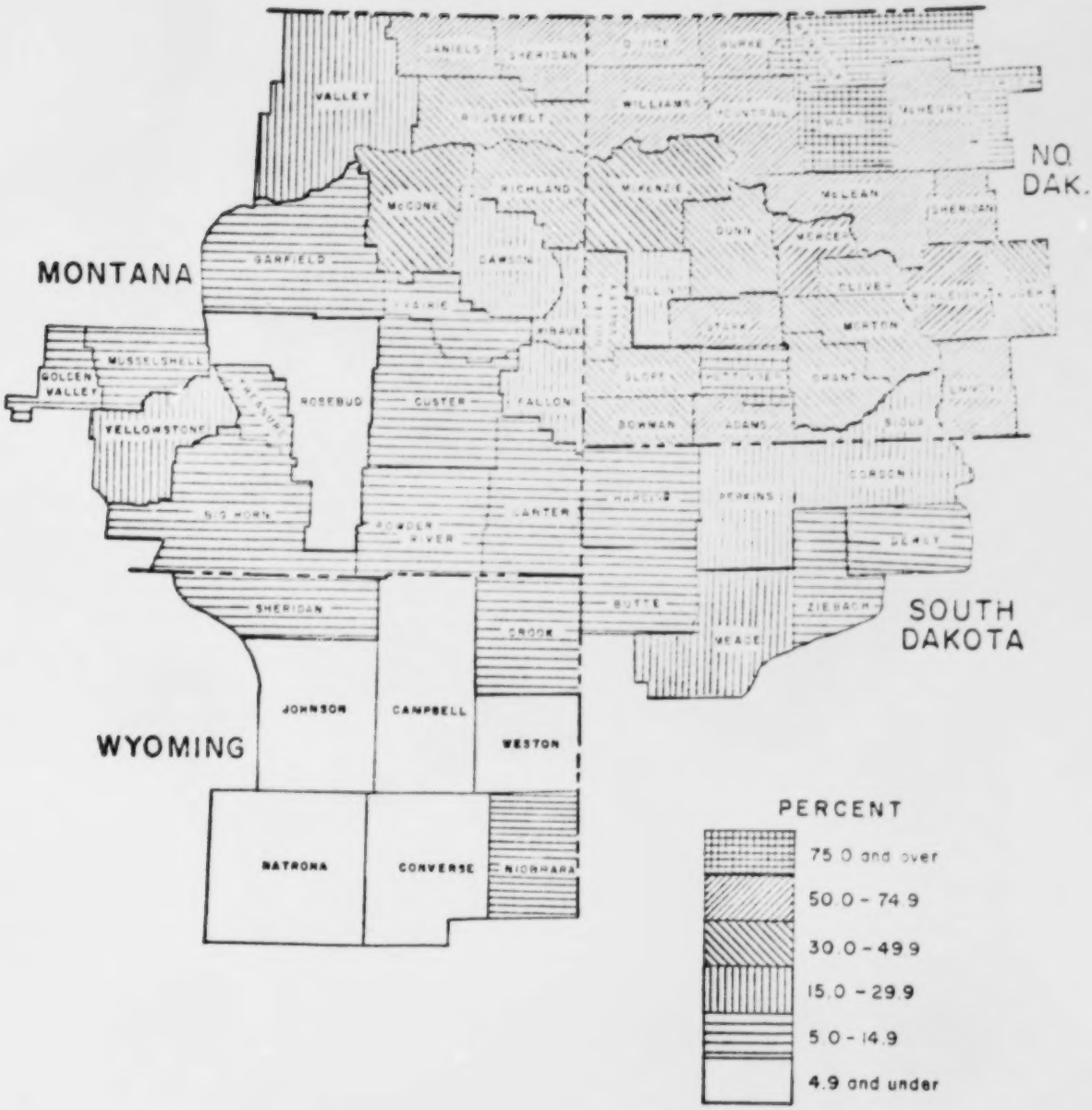

Figure 1.--Cropland as a percent of total land area in 1970 in the Northern Great Plains Resources Program area.

Table 4.--Livestock on farms and ranches by counties and states in January 1972 in the Northern Great Plains Resources Program study area

	All Cattle &Calves January 1, 1972	All Sheep & Lambs January 1, 1972	Hogs & Pigs December 1, 1971
Montana Counties			
Daniels	21,100	6,500	4,900
Dawson	50,400	17,500	4,900
Garfield	80,600	92,000	1,100
McCone	44,000	23,500	3,600
Richland	58,200	22,000	5,600
Roosevelt	40,900	7,000	6,300
Sheridan	32,000	3,000	5,600
Valley	87,800	13,500	6,000
Golden Valley	29,300	10,000	2,400
Musselshell	37,600	15,000	2,300
Big Horn	129,000	8,500	11,900
Treasure	31,800	2,800	1,400
Yellowstone	149,300	13,900	3,000
Carter	65,800	127,000	2,700
Custer	94,100	25,000	2,100
Fallon	46,300	9,500	5,400
Powder River	86,800	44,000	300
Prairie	43,500	6,500	3,900
Rosebud	99,200	23,500	3,300
Wibaux	24,300	9,500	2,300
Total	1,252,000	480,200	79,000
North Dakota Counties			
Burke	16,000	3,400	500
Divide	17,000	2,900	4,100
Mountrail	40,000	4,300	2,900
Renville	9,000	1,400	2,000
Ward	52,000	6,200	5,700
Williams	43,000	5,500	1,800
Bottineau	28,000	4,400	2,100
McHenry	75,000	4,400	6,100
Pierce	33,000	3,100	2,100
Dunn	95,000	3,800	6,200
McKenzie	102,000	5,700	3,600
McLean	69,000	4,900	5,700
Mercer	64,000	2,000	5,800
Oliver	37,000	2,600	7,700
Kidder	67,000	15,600	5,800
Sheridan	37,000	1,700	1,400
Adams	36,000	6,000	1,900

Table 4 (Cont'd)

	All Cattle & Calves January 1, 1972	All Sheep & Lambs January 1, 1972	Hogs & Pigs December 1, 197
North Dakota Counties (Cont'd)			
Billings	35,000	600	1,000
Bowman	33,000	29,000	4,500
Golden Valley	27,000	3,300	5,500
Hettinger	38,000	2,700	6,000
Slope	32,000	4,800	2,100
Stark	64,000	3,700	9,000
Burleigh	74,000	6,100	10,900
Emmons	71,000	1,200	9,500
Grant	77,000	6,300	14,600
Morton	109,000	5,600	16,000
Sioux	37,000	3,900	3,000
Total	1,417,000	145,100	147,500
South Dakota Counties			
Butte	55,000	184,500	4,150
Corson	68,000	17,900	14,500
Dewey	49,000	18,300	13,500
Harding	64,000	80,400	3,850
Perkins	89,000	61,700	13,700
Ziebach	42,000	19,800	9,000
Meade	124,000	54,000	6,250
Total	491,000	436,600	64,950
Wyoming Counties			
Campbell	84,500	130,700	1,150
Crook	67,600	62,400	1,720
Johnson	63,600	153,400	520
Sheridan	97,200	44,000	1,790
Weston	48,000	18,900	1,220
Natrona	68,400	223,500	1,080
Converse	74,900	112,700	1,940
Niobrara	65,100	45,700	1,850
Total	569,300	791,300	11,270

Table 5.--Crop production by counties and states in 1971 in the Northern Great Plains Resources Program study area

Montana Counties	All Wheat Harvested Acres	All Wheat Production Bushels	Barley Harvested Acres	Barley Production Bushels	Flax Harvested Acres	Flax Production Bushels
Daniels	230,200	4,936,300	26,500	689,000	2,400	19,200
Dawson	114,600	2,868,100	21,500	779,400	500	4,500
Garfield	30,400	680,400	10,000	290,000	-----	------
McCone	169,100	4,167,700	27,000	900,000	-----	------
Richland	121,400	3,462,300	31,000	1,343,800	600	5,400
Roosevelt	239,800	7,464,300	39,500	1,349,300	2,000	16,000
Sheridan	239,800	5,440,200	25,500	790,500	1,000	7,000
Valley	261,700	5,015,000	42,000	1,102,000	300	3,000
Golden Valley	15,100	406,300	8,000	264,000	-----	------
Musselshell	11,500	285,500	7,200	197,000	-----	------
Big Horn	56,800	1,716,800	25,500	1,046,000	-----	------
Treasure	4,100	125,600	2,300	132,600	-----	------
Yellowstone	77,100	2,344,100	39,500	1,579,500	-----	------
Carter	23,600	594,400	3,800	117,800	-----	------
Custer	13,500	353,600	4,600	113,700	-----	------
Fallon	67,000	1,934,200	10,100	358,600	-----	------
Powder River	22,200	663,400	3,500	98,700	-----	------
Prairie	35,500	1,024,200	7,200	197,600	-----	------
Rosebud	17,300	487,000	14,600	615,200	-----	------
Wibaux	47,900	1,197,300	5,200	192,400	100	900
Total	1,798,600	45,166,700	354,500	12,157,100	6,900	56,000

Table 5 (Cont'd)

North Dakota Counties	All Wheat Harvested Acres	All Wheat Production Bushels	Barley Harvested Acres	Barley Production Bushels	Flax Harvested Acres	Flax Production Bushels
Burke	134,300	3,308,700	18,000	738,000	3,500	31,500
Divide	176,800	4,497,200	14,000	546,000	1,000	8,500
Mountrail	205,400	4,860,700	13,000	468,000	3,500	29,750
Renville	130,000	3,284,400	38,000	1,444,000	14,500	145,000
Ward	263,500	6,733,300	45,000	1,755,000	23,000	184,000
Williams	251,900	5,238,600	15,000	615,000	1,000	8,500
Bottineau	250,900	5,714,700	63,000	2,457,000	34,000	357,000
McHenry	154,500	3,045,100	25,000	925,000	23,000	184,000
Pierce	120,200	2,438,800	32,000	1,280,000	32,500	357,500
Dunn	90,800	1,772,000	9,000	351,000	1,000	11,500
McKenzie	120,500	2,640,300	18,000	792,000	1,000	6,000
McLean	267,200	6,072,700	25,000	950,000	37,000	296,000
Mercer	74,300	1,342,200	4,000	136,000	5,000	50,000
Oliver	40,100	642,400	8,000	336,000	5,000	55,000
Kidder	46,100	727,300	12,000	480,000	16,000	144,000
Sheridan	99,400	2,236,600	12,000	444,000	20,500	174,250
Adams	91,500	1,743,700	7,000	273,000	1,500	15,000
Billings	23,700	498,300	3,000	126,000	500	4,500
Bowman	71,100	1,499,800	12,000	480,000	1,000	12,000
Golden Valley	59,400	1,282,400	7,000	315,000	500	4,500
Hettinger	164,200	3,387,300	15,000	540,000	1,500	19,500
Slope	61,700	1,349,600	8,000	336,000	500	4,250
Stark	123,000	2,616,700	10,000	420,000	1,000	7,000
Burleigh	83,500	1,402,200	16,000	592,000	27,000	216,000
Emmons	964,000	1,546,900	8,000	31,200	48,000	504,000
Grant	102,200	1,636,000	11,000	495,000	2,000	20,000
Morton	101,100	1,820,100	16,000	640,000	3,000	24,000
Sioux	23,400	302,100	3,000	224,000	2,000	17,000
Total	4,294,700	73,640,100	467,000	18,189,200	310,000	2,890,250

Table 5 (Cont'd)

	All Wheat		Barley		Flax	
	Harvested Acres	Production Bushels	Harvested Acres	Production Bushels	Harvested Acres	Production Bushels
South Dakota Counties						
Butte	14,470	534,650	1,400	53,200	-----	------
Corson	107,200	2,907,300	7,100	305,300	7,900	71,100
Dewey	51,900	1,368,600	2,800	103,600	1,500	12,800
Harding	30,300	804,200	4,100	151,700	400	3,200
Perkins	93,600	2,285,900	7,500	307,500	400	3,200
Ziebach	28,300	663,300	3,400	132,600	400	3,200
Meade	41,370	1,408,800	5,600	190,400	-----	------
Total	367,140	9,972,750	31,900	1,244,300	10,600	93,500
Wyoming Counties						
Campbell	23,300	731,600	6,200	218,200		
Crook	14,500	435,000	4,200	151,800		
Johnson	1,750	47,600	1,100	47,000		
Sheridan	6,050	172,600	8,400	317,200		
Weston	4,250	110,000	1,500	54,300		
Natrona	50	1,800	900	47,700		
Converse	2,700	67,500	3,500	126,000		
Niobrara	8,300	270,000	2,200	71,000		
Total	60,900	1,836,100	28,000	1,033,200		

Table 5 (Cont'd)

	Rye		Oats		Sugar Beets	
	Harvested Acres	Production Bushels	Harvested Acres	Production Bushels	Harvested Acres	Production T/Acre
Montana Counties						
Daniels	400	11,200	3,700	103,600	-----	-----
Dawson	100	3,200	11,000	470,000	2,610	19.1
Garfiled	---	------	5,400	156,600	-----	-----
McCone	100	3,600	3,400	122,400	-----	-----
Richland	---	------	18,500	920,900	10,070	19.9
Roosevelt	2,300	46,000	11,200	470,400	-----	-----
Sheridan	---	------	7,100	258,000	-----	-----
Valley	1,400	32,200	4,700	146,100	-----	-----
Golden Valley	---	------	4,500	123,300	-----	-----
Musselshell	100	2,500	600	21,900	-----	-----
Big Horn	100	1,900	4,400	166,000	-----	-----
Treasure	---	------	400	30,000	3,870	22.7
Yellowstone	---	------	2,400	127,200	12,490	20.8
Carter	---	------	5,700	222,300	-----	-----
Custer	---	------	4,000	151,000	1,780	23.2
Fallon	100	1,000	5,500	249,500	-----	-----
Powder River	---	------	5,700	221,100	-----	-----
Prairie	---	------	3,600	147,100	1,710	19.7
Rosebud	---	------	4,100	192,400	1,560	18.1
Wibaux	---	------	3,400	149,600	-----	-----
Total	4,600	101,600	109,300	4,449,400	34,090	143.5
North Dakota Counties						
Burke	3,000	84,000	14,000	756,000	-----	-----
Divide	2,500	67,500	12,000	576,000	-----	-----
Mountrail	3,500	94,500	32,000	1,600,000	-----	-----
Renville	5,000	150,000	23,000	1,196,000	-----	-----
Ward	4,500	130,500	53,000	2,491,000	-----	-----
Williams	6,500	201,500	19,000	931,000	2,440	17.5
Bottineau	12,500	387,500	39,000	1,950,000	-----	-----
McHenry	10,500	262,500	62,000	2,728,000	-----	-----

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Table 5 (Cont'd)

North Dakota Counties	Rye Harvested Acres	Rye Production Bushels	Oats Harvested Acres	Oats Production Bushels	Sugar Beets Harvested Acres	Sugar Beets Production T/Acre
Pierce	4,500	126,000	42,000	1,890,000	-----	-----
Dunn	1,000	34,000	39,000	1,950,000	-----	-----
McKenzie	1,000	32,000	26,000	1,222,000	4,760	18.5
McLean	6,000	222,000	55,000	2,585,000	270	16.3
Mercer	500	15,500	32,000	1,508,000	-----	-----
Oliver	500	12,500	21,000	1,050,000	250	18.6
Stutsman	4,000	128,000	45,000	2,340,000	-----	-----
Sheridan	1,500	39,000	25,000	1,100,000	-----	-----
Adams	4,000	144,000	20,000	980,000	-----	-----
Billings	500	15,500	12,000	600,000	-----	-----
Bowman	4,000	108,000	21,000	882,000	-----	-----
Golden Valley	500	15,000	13,000	611,000	-----	-----
Bottinger	10,500	346,500	27,000	1,431,000	-----	-----
Slope	7,500	247,500	13,000	572,000	-----	-----
Stark	3,000	90,000	44,000	2,464,000	-----	-----
Burleigh	1,500	39,000	50,000	2,450,000	-----	-----
Emmons	6,500	182,000	54,000	2,970,000	-----	-----
Grant	4,000	116,000	42,000	2,184,000	-----	-----
Morton	1,500	43,500	59,000	3,127,000	-----	-----
Sioux	1,500	48,000	17,000	918,000	-----	-----
Total	112,000	3,385,000	908,000	45,062,000	7,760	70.9
South Dakota Counties						
Butte	40	1,400	6,000	276,000	-----	-----
Corson	2,400	76,800	31,000	1,658,500	-----	-----
Dewey	1,700	51,000	19,600	940,800	-----	-----
Harding	600	17,400	13,500	681,800	-----	-----
Perkins	1,000	32,000	22,800	980,400	-----	-----
Ziebach	340	10,200	7,800	327,600	-----	-----
Meade	800	24,000	20,400	938,400	-----	-----
Total	6,880	212,800	121,100	5,803,500	-----	-----

Table 5 (Cont'd)

Wyoming	Rye Harvested Acres	Rye Production Bushels	Oats Harvested Acres	Oats Production Bushels	Sugar Beets Harvested Acres	Sugar Beets Production T/Acre
Campbell	-----	-----	3,000	106,500	-----	-----
Crook	-----	-----	4,400	161,200	-----	-----
Johnson	-----	-----	1,700	95,800	-----	-----
Sheridan	-----	-----	2,600	115,700	-----	-----
Weston	-----	-----	2,600	96,200	-----	-----
Natrona	-----	-----	2,300	126,500	-----	-----
Converse	-----	-----	2,600	125,800	450	5,940
Niobrara	-----	-----	4,500	174,600	360	5,510
Total	-----	-----	23,700	1,002,300	810	11,450

Montana Counties	Corn Acres Planted	Alfalfa Hay Harvested Acres
Daniels	100	5,900
Dawson	4,200	8,300
Garfield	1,200	7,000
McCone	800	7,100
Richland	8,300	18,000
Roosevelt	1,700	16,100
Sheridan	800	5,600
Valley	2,000	32,200
Golden Valley	100	10,500
Musselshell	700	11,500
Big Horn	7,000	47,500
Treasure	2,300	8,300
Yellowstone	12,000	19,200
Carter	1,100	30,500
Custer	5,200	17,700
Fallon	3,800	17,900
Powder River	100	37,100
Prairie	4,000	6,200

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Table 5 (Cont'd)

	Corn Acres Planted	Alfalfa Hay Harvested Acres
Montana Counties		
Rosebud	3,100	29,100
Wibaux	1,600	4,600
Total	60,100	340,300
North Dakota Counties		
Burke	100	8,000
Divide	200	2,000
Mountrail	400	17,000
Renville	1,000	7,000
Ward	3,200	34,000
Williams	2,100	20,000
Bottineau	1,700	15,000
McHenry	7,400	33,000
Pierce	2,800	14,000
Dunn	20,800	52,000
McKenzie	4,300	22,000
McLean	8,400	30,000
Mercer	17,700	31,000
Oliver	13,800	30,000
Kidder	7,600	75,000
Sheridan	2,500	21,000
Adams	11,300	23,000
Billings	1,900	10,000
Bowman	5,000	20,000
Golden Valley	5,000	6,000
Hettinger	3,800	20,000
Slope	2,600	17,000
Stark	14,100	44,000

The location of total cropland in 1970 is shown graphically in Figure 2. In general, the counties in North Dakota and the seven northeastern counties of Montana have a greater percentage of their land in crops than does the rest of the area.

Irrigated acres of cropland by counties in 1970 are shown in Figure 3.

Detailed land use statistical data by counties and states are contained in Table 6. These include total land area, cropland (total acres), irrigated acres, and nonirrigated acres, pastureland and rangeland, and forest and woodland.

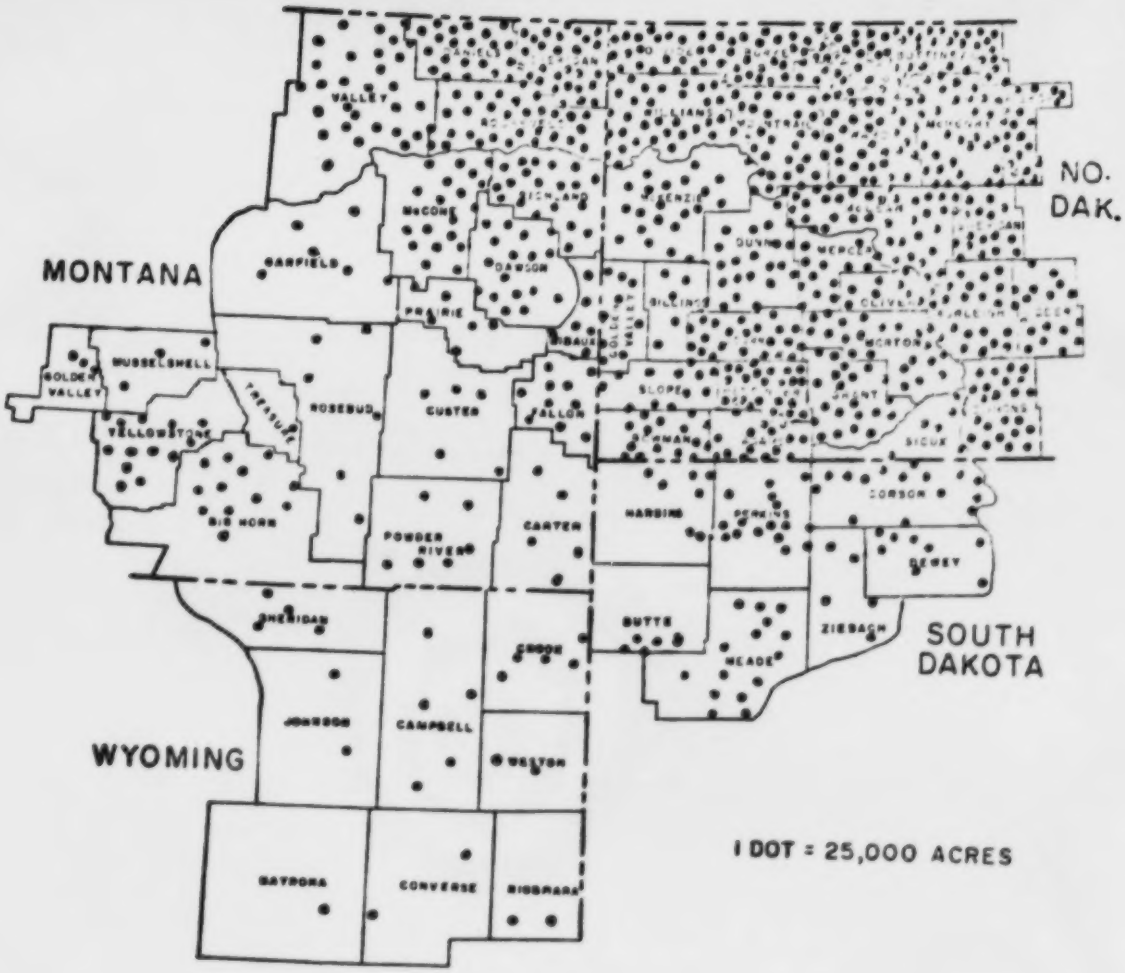

Figure 2.--Distribution of cropland by counties in 1970 in the Northern Great Plains Resources Program area.

Reproduced from best available copy.

Figure 3.--Acres of irrigated land in farms by counties in 1970 in the Northern Great Plains Resources Program area.

Table 6.--NGPRP area agricultural land use statistics (in acres)

State	Total land area 1/	Cropland			Pastureland & rangeland acres	Forest & woodland acres	Urban and built-up areas 2/
		Total acres	Irrigated acres	Non-irrigated acres			
Montana	34,100,834	6,284,575	361,435	5,923,140	26,419,864	1,649,238	272,197
North Dakota	25,832,575	14,705,446	55,119	14,650,327	10,434,323	154,400	546,006
South Dakota	11,510,161	1,822,007	64,637	1,757,370	9,548,375	154,638	31,084
Wyoming	18,472,441	696,412	212,446	483,966	16,140,104	1,716,752	305,608
NGPRP study area	89,916,011	23,508,440	693,637	22,814,803	62,542,666	3,675,028	1,154,895

1/ Source: U.S. Bureau of the Census, 1970, as modified by State Conservation Needs Inventory.

2/ Source: Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

(Overall source: U.S. Census of Agriculture, 1969, plus published and unpublished federal agency data. Land use statistics may exceed state acreage totals due to the grazing of forested lands.)

Table 6.-- (Cont'd)

State Montana

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-Irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
1	Big Horn	Hardin	3,214,020	294,794	48,400	246,394	2,708,604	335,874	11,979
2	Carter	Ekalaka	2,114,383	133,561	13,919	119,642	1,911,878	72,064	6,784
3	Custer	Miles City	2,394,948	122,925	28,658	94,267	2,208,767	66,738	14,307
4	Daniels	Scobey	921,482	555,865	1,269	554,596	356,367	---	9,250
5	Dawson	Glendive	1,515,122	430,389	12,152	418,237	1,055,499	13,749	20,515
6	Fallon	Baker	1,043,452	254,561	2,532	252,029	777,544	---	11,347
7	Garfield	Jordan	2,848,072	154,975	3,234	151,741	2,626,303	99,440	16,388
8	Golden Valley	Ryegate	752,195	76,841	7,465	69,376	636,743	50,484	7,053
9	McCone	Circle	1,663,758	504,416	5,242	499,174	1,140,404	6,738	13,765
10	Musselshell	Roundup	1,206,195	75,360	8,124	67,236	941,886	258,513	14,100
11	Powder River	Broadus	2,102,528	154,942	13,215	141,727	1,701,876	279,168	6,200
12	Prairie	Terry	1,106,364	130,218	8,919	121,299	967,328	---	8,818
13	Richland	Sidney	1,326,416	515,732	32,316	483,416	788,678	15,361	12,755
14	Roosevelt	Wolf Point	1,523,696	737,061	6,832	730,229	762,204	9,700	16,329
15	Rosebud	Forsyth	3,220,320	148,158	34,993	113,165	2,874,806	280,269	5,208
16	Sheridan	Plentywood	1,081,376	717,809	1,328	716,481	347,569	645	15,998

1/ Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, U.S.D.A.

State Montana

Table 6 (Cont'd)

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
17	Treasure	Hysham	629,343	37,176	16,209	20,967	561,793	39,349	4,115
18	Valley	Glasgow	3,178,600	747,414	35,398	712,016	2,385,694	32,497	25,953
19	Wibaux	Wibaux	568,376	152,227	458	151,769	409,149	---	7,000
20	Yellow-stone	Billings	1,690,188	340,151	80,772	259,379	1,256,772	88,649	44,333
	Total		34,100,834	6,284,575	361,435	5,923,140	26,419,864	1,649,238	272,197

Note: A. Overall Source: U.S. Census of Agriculture, 1969, plus published and unpublished Federal Agency Data.

B. Land use statistics may exceed county acreage totals due to the grazing of forested lands.

1/ Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, U.S.D.A.

State North Dakota

Table 6 (Cont'd)

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-Irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
1	Adams	Hettinger	632,938	392,723	331	392,392	226,477	200	13,538
2	Billings	Medora	727,344	129,849	47	129,802	575,931	12,600	10,964
3	Bottineau	Bottineau	1,067,558	929,938	116	929,822	67,233	41,800	29,887
4	Bowman	Bowman	748,586	370,910	1,323	369,587	367,532	500	9,644
5	Burke	Bowbells	705,266	493,730	---	493,730	190,663	400	20,473
6	Burleigh	Bismarck	1,038,497	552,596	4,702	547,894	453,055	5,700	27,346
7	Divide	Crosby	831,557	573,936	998	572,938	236,146	---	21,475
8	Dunn	Manning	1,276,008	487,887	1,053	486,834	741,085	34,500	12,536
9	Emmons	Linton	952,528	582,707	870	581,837	330,800	4,100	35,021
10	Golden Valley	Beach	648,960	240,124	330	239,794	399,441	---	9,395
11	Grant	Carson	1,063,657	523,559	1,875	521,684	519,975	700	19,423
12	Hettinger	Mott	726,005	599,023	135	598,888	111,265	200	15,517
13	Kidder	Steele	865,410	424,963	916	424,047	427,169	1,300	11,978
14	McHenry	Towner	1,196,661	802,679	3,129	799,550	362,175	---	31,807
15	McKenzie	Watford City	1,750,400	535,280	17,116	518,164	1,188,016	19,300	9,804
16	McLean	Washburn	1,315,505	966,678	772	965,906	309,778	7,000	32,249

Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

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State North Dakota

Table 6 (Cont'd)

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-Irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
17	Mercer	Stanton	665,604	343,052	1,025	342,027	299,322	1,900	21,430
18	Morton	Mandan	1,228,060	565,442	2,011	563,431	639,981	4,500	18,237
19	Mountrail	Stanley	1,160,029	725,554	555	724,999	410,418	1,900	22,257
20	Oliver	Center	460,819	208,922	2,193	206,729	239,697	2,900	9,400
21	Pierce	Rugby	655,501	547,856	---	547,856	89,322	200	18,123
22	Renville	Mohall	566,624	461,444	316	461,128	96,556	---	8,624
23	Sheridan	McClusky	621,912	398,315	---	398,315	205,454	900	17,243
24	Sioux	Fort Yates	700,584	148,406	607	147,799	544,718	4,100	3,460
25	Slope	Amidon	782,359	296,140	218	295,922	471,860	5,100	9,459
26	Stark	Dickinson	838,261	576,244	505	575,739	232,575	600	28,842
27	Ward	Minot	1,290,369	982,596	952	981,644	258,124	3,100	46,649
28	Williams	Williston	1,316,573	844,893	13,024	831,869	439,555	900	31,225
	Total		25,832,575	14,705,446	55,119	14,650,327	10,434,323	154,400	546,006

Note: A. Overall Source: U.S. Census of Agriculture, 1969, plus published and unpublished Federal Agency Data.

B. Land use statistics may exceed county acreage totals due to the grazing of forested lands.

Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, USDA.

State South Dakota

Table 6 (Cont'd)

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-Irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
1	Butte	Belle Fourche	1,433,480	130,362	50,262	80,100	1,294,663	12,253	3,780
2	Corson	McIntosh	1,573,728	374,614	1,160	373,454	1,184,300	13,573	5,100
3	Dewey	Timber Lake	1,502,176	223,170	---	223,170	1,274,920	2,128	2,563
4	Harding	Buffalo	1,704,292	181,434	4,190	177,244	1,505,266	20,346	1,410
5	Meade	Sturgis	2,210,488	377,500	6,035	371,465	1,748,642	97,377	14,498
6	Perkins	Bison	1,823,411	411,640	2,384	409,256	1,407,884	1,694	2,674
7	Ziebach	Dupree	1,262,586	123,287	606	122,681	1,132,700	7,267	1,059
	Total		11,510,161	1,822,007	64,637	1,757,370	9,548,375	154,638	31,004

Note: A. Overall Source: U.S. Census of Agriculture, 1969, plus published and unpublished Federal Agency Data.

B. Land use statistics may exceed county acreage totals due to the grazing of forested lands.

1/ Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, U.S.D.A.

State Wyoming

Table 6 (Cont'd)

	COUNTY	COUNTY SEAT	TOTAL LAND 1/ AREA	CROPLAND Total Acres	CROPLAND Irrigated Acres	CROPLAND Non-Irrigated Acres	Pastureland & Rangeland Acres	Forest & Woodland Acres	Urban & Built Up Areas
1	Campbell	Gillette	3,033,281	124,659	2,480	122,179	2,821,215	56,387	56,411
2	Converse	Douglas	2,729,129	60,340	40,920	19,420	2,503,742	207,068	37,595
3	Crook	Sundance	1,833,292	145,090	7,171	137,919	1,182,882	508,306	31,462
4	Johnson	Buffalo	2,658,363	60,336	41,629	18,707	2,297,984	344,673	53,108
5	Natrona	Casper	3,410,107	43,086	38,963	4,123	3,269,363	78,419	57,750
6	Niobrara	Lusk	1,662,895	88,302	14,601	73,701	1,551,328	17,324	15,387
7	Sheridan	Sheridan	1,613,860	118,491	60,801	57,690	1,191,328	329,179	37,525
8	Weston	Newcastle	1,531,514	56,108	5,881	50,227	1,322,262	175,396	16,370
	Total		18,472,441	696,412	212,446	483,966	16,140,104	1,716,752	305,608

Note: A. Overall Source: U.S. Census of Agriculture, 1969, plus published and unpublished Federal Agency Data.

B. Land use statistics may exceed county acreage totals due to the grazing of forested lands.

1/ Source: U.S. Bureau of the Census 1970 as modified by State Conservation Needs Inventory, 1970, Soil Conservation Service, U.S.D.A.

Discussion draft
February 1974

WILDERNESS

I. INTRODUCTION

This section describes the existing and potential wild land resources and their tangible and intangible values within the Fort Union-Powder River region and those areas outside this region, presently designated or proposed as Wilderness, Primitive, or by special administrative designation where impacts of mineral development could change their character. This profile is concerned with undeveloped lands where most of the options for management still exist. These include all areas which are roadless or essentially roadless.

II. PROCEDURE

The procedure involved the identification of lands within the study area that would meet specific criteria which included:

1. Existing units of the National Wilderness Preservation System.
2. Proposed units to the National Wilderness Preservation System.
3. Lands established as Primitive by regulation of the Secretary of the Interior.
4. Lands proposed for establishment as Primitive by regulation of the Secretary of the Interior.
5. Other inventoried wild lands within the study area.

Inventory criteria included such items as the presence or absence of low standard roads, such structures as dams and storage facilities, watershed restoration work, intensive range management systems, and natural environment and opportunities for a back country type experience.

Participating agencies prepared a short written description of each area and referenced it to a map. As a minimum, this included:

1. Approximate acreage by Federal, State, and private ownership.
2. A general discription of the area based on the resource information currently available.
3. Identification of special features contained within the areas.
4. Other information believed significant.
5. A rating of the quality index of each area. (See Appendix 1.)

III. RESULTS

The wild land resource includes:

1. "Wild Land"

An area which generally appears to be undeveloped, unimproved, and not regularly cultivated; but is capable of producing products or resources while remaining essentially wild. These lands often contain cultural and historic values which are essential in the maintenance of a way of life. These lands often possess steep and irregular topography and represent a segment of the landscape which appears essentially natural, but may contain various past impacts of man. Examples include desert, tundra, forest, badlands, grasslands, prairie, savannah, or pothole lands. Types of use may include range land, abandoned farmland, water development

projects, areas containing unsurfaced roads, and areas of sparse mineral extraction, storage, and transportation. These areas would be devoted to the maintenance of existing ecosystems, while providing opportunities for the utilization of renewable resources at a sustained yield level.

Wild land includes those areas designated as "Natural" by the Secretary of Agriculture or "Primitive" by the Secretary of the Interior and other identified, undeveloped land areas.

2. Existing Wilderness

As defined by the Wilderness Act, Public Law 88-577:

"A Wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (a) generally appear to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (b) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (c) has at least 5,000 acres of land or is of sufficient size as to make practicable its

preservation and use in an unimpaired condition; and (d) may also contain ecological, geological, or other features of scientific, scenic, or historical value."

3. Proposed Wilderness

Areas of land that meet the criteria for a Wilderness as defined by the Wilderness Act PL 88-577. Establishment of these lands as a unit of the National Wilderness Preservation System is subject to Congressional action.

Units of the National Wilderness Preservation System

There are no units of the National Wilderness Preservation System within the study area (Figure 1). Several units lay within the drainage area of the Missouri River Basin. (Table 1) It is important to consider what impacts may occur on existing Wilderness outside the study area in relation to possible increased use (Table 2) and water demands in the form of actual improvements or weather modification.

Wilderness is both a condition of physical geography and a state of mind which varies from one individual to the next. The Forest Service gave early recognition to preservation of wilderness, and, in 1924, the agency designated specific areas as Wilderness within the National Forests. The Wilderness Act of September 3, 1964, accepted and established as a national policy to secure for the American people of present and future generations the benefits of an enduring resource of wilderness.

Figure 1.--National Forest Wildernesses and Primitive Areas as of November 1, 1972 in the 11 Western States.

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Table 1--UNITS OF THE WILDERNESS PRESERVATION SYSTEM OUTSIDE STUDY AREA

NAME OF AREA	SIZE	PRESENT USE VISITOR DAYS	DESCRIPTION	POTENTIAL FOR WATER DEVELOPMENT							
				COUNTY	SITE	STREAM	ACRES	PURPOSE*	T	R	DRAINAGE AREA (SQUARE MILES)
ANACONDA-PINTLAR MONTANA	159,086	24,700	A SCENIC CHAIN OF HIGH BARREN AND PRECIPITOUS PEAKS ALONG THE CONTINENTAL DIVIDE. FORESTED SLOPES OF SPRUCE AND LODGEPOLE FLANK THE CREST. NUMEROUS LAKES AND STREAMS.	BEAVERHEAD	PINTLAR LAKE	PINTLAR CREEK	283	I	1N	15W	16
				BEAVERHEAD	PINTLAR FALLS	PINTLAR CREEK	323	I	1N	15W	13
				DEER LODGE	STOREY	LA MARCHE CREEK	528	I	2N	13W	33
GATES-OF-THE-MOUNTAIN MONTANA	28,562	2,200	SPECTACULAR LIMESTONE CLIFFS & OTHER GEOLOGIC FORMATIONS OF INTEREST RELATING TO THE LEWIS & CLARK EXPEDITION.								
BOB MARSHALL MONTANA	950,000	115,300	A SPECTACULAR MOUNTAIN AREA WITH A WIDE VARIETY OF FLORA AND FAUNA. OF GREAT GEOLOGIC INTEREST CLIMAXED BY THE CHINESE WALL.	FLATHEAD	MEADOW CREEK	S. FK. FLATHEAD RIVER	---	I	24N	14W	--
				LEWIS & CLARK	CASTLE REEF	SUN R.	3,330	I F	22N	9W	609
				"	LOWER SUN BUTTE	SUN R.	3,870	I F	22N	10W	513
				"	PARIS	N. FK. SUN R.	564	I	22N	10W	230
				"	UPPER SUN BUTTE	"	2,565	I F	22N	10W	260
WASHAKIE WYOMING	687,608	30,000	THIS AREA IS A FAVORITE OF THE EARLY FALL BIG GAME TROPHY HUNTER AND THE SUMMER WILDERNESS TRAIL RIDER. ITS GREAT SIZE, MANY MILES OF TRAILS, AND SUPERLATIVE SCENERY PLACE IT HIGH ON THE LIST FOR A TRUE WILDERNESS EXPERIENCE. IT IS ALSO RICH IN PETRIFIED REMAINS OF FORESTS, FERNS, AND ANIMAL LIFE.			NOT AVAILABLE AT PRESENT TIME					

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Table 1--UNITS OF THE WILDERNESS PRESERVATION SYSTEM OUTSIDE STUDY AREA

NAME OF AREA	SIZE	PRESENT USE VISITOR DAYS	DESCRIPTION	POTENTIAL FOR WATER DEVELOPMENT							
				COUNTY	SITE	STREAM	ACRES	PURPOSE*	T	R	DRAINAGE AREA (SQUARE MILES)
NORTH ABSAROKA WYOMING	351,140	14,700	THIS AREA IS BEST KNOWN FOR ITS BIG GAME HUNTING AND FOR FISHING. IT CONTAINS GLACIERS, A NATURAL BRIDGE, AND STANDING PETRIFIED TREES.	NOT AVAILABLE AT PRESENT TIME							
SCAPEGOAT MONTANA	240,000	---	UNIQUE AND INTERESTING GEOLOGIC FORMATIONS AND BROAD EXPANSES OF ALPINE AND SUBALPINE COUNTRY THAT DISPLAY SPARSE VEGETATION AS A RESULT OF LONG WINTERS, DEEP SNOWS, AND ROCKY TERRAIN. BROAD MOUNTAIN VALLEYS WITH INTERSPERSED HEAVY STAND OF TREES.	LEWIS & CLARK	COONEY CR.	N. FK. BLACKFOOT RIVER	---	I	17N	10W	---
				"	HEINZE	N. FK. BLACKFOOT RIVER	---	P	17N	10W	---
				POWELL	LOST PONY CREEK	E. FK. BLACKFOOT RIVER	---	I	16N	10W	---
				MISSOULA	MEADOW CREEK	E. FK. BLACKFOOT RIVER	---	I	17N	10W	---
				LEWIS & CLARK	DEARBORN	DEARBORN R.	750	I	17N	8W	57
TETON WYOMING	563,500	118,100	THIS IS A REGION OF HIGH PLATEAUS, LARGE VALLEYS, AND MOUNTAIN MEADOWS THAT CAN BE EASILY TRAVERSED. OF SPECIAL INTEREST IS TWO OCEAN PASS, WHERE TWO OCEAN CREEK DIVIDES AND SENDS ONE STREAM TO THE PACIFIC AND ONE TO THE ATLANTIC. NOTED FOR ELK HUNTING AND FISHING--IT IS SUMMER RANGE FOR JACKSON HOLE ELK HERD.	NOT AVAILABLE AT PRESENT TIME							

*ALL WATER POTENTIAL DATA EXCERPTED FROM, "SUMMARY OF POTENTIAL PROJECTS IN MONTANA, INVENTORY SERIES NO. 9, MONTANA WATER RESOURCES BOARD, JUNE 1969."

I - IRRIGATION
P - POWER
F - FLOOD CONTROL

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Table 3-- KINDS OF ACTIVITIES - VISITOR DAYS USE

	Enjoy Unique/ Unusual Environment	Ice & Snow Craft (Motor)	Hiking & Walking	Horseback Riding	Watercraft (Row, Drift, Raft)	Swimming & Bathing	Cold Water Fishing	General Camping	Tent Camping	Big Game Hunting	Small Game Hunting	Upland Bird Hunting	Waterfowl Hunting	Nature Study	Mountain Climbing	Gathering Forest Products	Acquiring General Knowledge Understanding	Guided Touring	Unguided Touring	Total Visitor Days of Use
Anaconda-Pintlar Wilderness, Region 1	3,100	—	3,800	1,600	200	200	4,000	1,400	2,000	4,800	300	600	—	500	400	200	600	600	400	24,700
Bob Marshall Wilderness, Region 1	13,200	—	25,000	15,100	600	—	10,200	11,000	6,900	29,500	100	700	—	2,100	100	100	700	—	—	115,300
Cabinet-of-the-Mountain Wilderness, Region 1	300	—	300	—	—	—	—	200	100	800	100	100	—	100	—	—	—	100	—	2,300
Mashkin Wilderness, Region 2	4,300	—	2,300	3,600	—	—	1,900	6,300	6,200	9,900	—	—	—	700	300	1,300	700	100	—	38,000
North Absaroka Wilderness, Region 2	600	—	300	2,600	—	—	2,800	1,000	1,800	4,700	—	—	—	200	100	—	300	—	100	14,700
Scapegoat Wilderness, Region 1																			Use Figures Not Available at This Time	
Teton Wilderness, Region 4	23,100	—	1,400	3,700	—	—	3,800	13,300	40,000	23,900	300	300	300	1,700	—	—	2,300	—	—	118,100

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Table 3--KINDS OF ACTIVITIES - VISITOR DAYS USE

	Enjoy Unique/ Unusual Environment	Ice & Snow Craft (Motor)	Hiking & Walking	Horseback Riding	Watercraft (Row, Drift, Raft)	Swimming & Bathing	Cold Water Fishing	General Camping	Tent Camping	Big Game Hunting	Small Game Hunting	Upland Bird Hunting	Waterfowl Hunting	Nature Study	Mountain Climbing	Gathering Forest Products	Acquiring General Knowledge Understanding	Guided Touring	Unguided Touring	Total Visitor Days of Use
Absaroka Primitive Area, Region 1	400	—	200	2,900	—	—	1,000	500	1,900	7,800	100	100	—	200	100	100	200	—	—	15,500
Beartooth Primitive Area, Region 1	4,800	—	18,800	4,400	200	—	30,600	13,900	18,300	6,100	200	1,100	—	2,900	3,100	300	4,900	3,800	—	110,800
Spanish Peaks Primitive Area, Region 1	1,500	—	4,600	3,300	—	—	1,100	500	3,000	2,000	—	300	—	300	200	200	200	—	—	17,300
Cloud Peak Primitive Area, Region 2	2,600	200	16,300	7,400	700	100	14,000	2,700	8,100	1,000	100	100	—	700	1,100	100	1,300	300	600	37,400
Glacier Primitive Area, Region 2	2,100	—	3,700	1,200	100	—	4,400	7,100	4,900	500	—	—	—	600	4,700	—	2,000	—	—	31,300
Popo Agie Primitive Area, Region 2	1,100	—	3,800	700	—	—	7,100	4,400	8,900	300	—	—	—	—	3,100	—	1,300	—	—	29,700

The Act charged the Secretaries of the Interior and Agriculture to review the lands they manage for their possible addition to the National Wilderness Preservation System.

Agencies administering any area designated as Wilderness are responsible for preservation of its wilderness character. Thus, management emphasis is placed on maintaining and restoring the natural condition of each Wilderness. These areas provide opportunities for a primitive, unconfined experience, with a measure of solitude. Mechanized equipment is not permitted, except in cases of emergency; trees are not cut; and roads and all developments, except foot and horse trails, are prohibited. Fishing, hunting, camping, hiking, and grazing of domestic livestock are permitted.

Both the intangible and physical values of Wilderness can be compromised while still within the intent of the Act. Wilderness use is the fastest growing type of recreational activity. No management efforts, short of limitation of visitors, can prevent deterioration of the resource. Carrying capacities are not estimated for any units of Wilderness.

Mineral activity under the United States mining laws, other laws pertaining to mineral leasing, and other regulations of Secretaries of Agriculture and the Interior can continue until January 1, 1984. Thereafter, subject to existing rights, all lands are withdrawn from mineral entry unless there is a demonstrated national need.

The President may authorize the prospecting for water resources, establishment and maintenance of reservoirs, water conservation works, power projects, transmission lines, and other facilities needed in the public interest, if he determines that these intrusions will better serve the interests of the United States.

Another form of impact that will change the natural environment of a Wilderness is weather modification. Not much is known of the effects of weather modification; however, increased precipitation over long periods of time may result in vegetation changes, changes in soils, increased channelization and population makeup, and distribution of wildlife.

Proposed Units of the National Wilderness Preservation System Outside the Study Area

There are several proposed and potential areas to the National Wilderness Preservation System located outside the study area in the Missouri River Basin. These may be affected by either increased use or water improvements. These areas comprise 2,978,231 acres of land which meet the definition of wilderness (Table 3). Several of these areas have been proposed to Congress; others are under study for the possible inclusion.

On October 15, 1973, the Chief of the Forest Service released a list of New Wilderness Study Areas. These areas appear to have the highest wilderness potential of all of the roadless and undeveloped National Forest land. The New Study Areas will be managed to preserve their wilderness characteristics.

Table 3-- AREAS OUTSIDE STUDY AREA BEING CONSIDERED FOR INCLUSION IN NATIONAL WILDERNESS PRESERVATION SYSTEM

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NAME OF AREA	SIZE	PRESENT USE VISITOR DAYS	DESCRIPTION	POTENTIAL FOR WATER DEVELOPMENT							
				COUNTY	SITE	STREAM	ACRES	PURPOSE*	T	R	DRAINAGE AREA (SQUARE MILES)
ABSAROKA P.A. MONTANA UNDER STUDY BY USDA-FS	64,000	15,500	HIGH MOUNTAIN AREA MAINLY WOODED AND LOFTY PEAKS. OPPORTUNITY FOR SOLITUDE DUE TO ACCESS.								
BEARTOOTH P.A. MONTANA UNDER STUDY BY USDA-FS	230,000	110,800	RUGGED, HIGH MOUNTAIN AREA. INCLUDES GRANITE PEAK (HIGHEST IN MONTANA) AND GRASSHOPPER GLACIER, HIGH TUNDRA PLATEAUS AND MANY LAKES.	CARBON	BLACK CANYON LAKE	BLACK CANYON CREEK	---	I	9S	18E	---
				PARK	BROAD-WATER CURL L.	FISHER CR. (CLARKS FK.)	---	I	9S	15E	---
				CARBON	EAST ROSE-BUD L.	E. ROSE-BUD CR.	---	P	7S	17E	---
				CARBON	GRANITE L.	CLARKS FK. YELLOW-STONE R.	---	I	9S	17E	---
				CARBON	KEYSER L.	L. FK. ROCK CR.	25	I	8S	18E	---
				CARBON	L. CR. #5	L. FK. ROCK CR.	---	I	9S	18E	---
				CARBON	QUINNE-BAUGH MEADOWS	W. FK. ROCK CR.	---	I	8S	18E	16
				CARBON	SECOND L.	L. FK. ROCK CR.	---	I	8S	18E	---
				STILLWATER	SIOUX CHARLIE LAKE	STILLWATER	---	P	6S	15E	---
				CARBON	THIRD L.	L. FK. ROCK CR.	47	I	8S	17E	---
SPANISH PEAKS P.A. MONTANA PROPOSAL TO CONGRESS	50,776	17,300	WILD, MODERATELY ROUGH TOPOGRAPHY DEPICTING ALPINE GLACIATION.	GALLATIN	LOWER BASIN	GALLATIN RIVER	3,050	P	6S	4E	530
GLACIER P.A. WYOMING UNDER STUDY BY USDA-FS	177,000	31,300	THIS REGION TAKES ITS NAME FROM SOME OF THE LARGEST LIVING GLACIERS WITHIN THE CONTINENTAL UNITED STATES. MUCH OF THE AREA IS BARE GRANITE ROCK, PLANED OFF BY RECENT OR LIVING GLACIERS. THERE ARE NUMEROUS ALPINE LAKES.	NOT AVAILABLE AT PRESENT TIME							

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Table 3--AREAS OUTSIDE STUDY AREA BEING CONSIDERED FOR INCLUSION IN NATIONAL WILDERNESS PRESERVATION SYSTEM

NAME OF AREA	SIZE	PRESENT USE VISITOR DAYS	DESCRIPTION	POTENTIAL FOR WATER DEVELOPMENT							
				COUNTY	SITE	STREAM	ACRES	PURPOSE*	T	R	DRAINAGE AREA (SQUARE MILES)
POPO AGIE P.A. WYOMING UNDER STUDY BY USDA-FS	70,000	29,700	LYING ALONG THE CONTINENTAL DIVIDE, THE POPO AGIE FEATURES OVER 200 LAKES, HIGH, JAGGED PEAKS, AND DEEP NARROW CANYONS. SEVEN MAJOR TRAILS PROVIDE A JOURNEY THROUGH GEOLOGIC HISTORY.	NOT AVAILABLE AT PRESENT TIME							
YELLOWSTONE NATIONAL PARK WYOMING UNDER STUDY BY PARK SERVICE	2,016,181	---		NOT AVAILABLE AT PRESENT TIME							
GRAND TETON NATIONAL PARK WYOMING UNDER STUDY BY PARK SERVICE	310,350	---		NOT AVAILABLE AT PRESENT TIME							
BADLANDS NATIONAL MONUMENT SOUTH DAKOTA UNDER STUDY BY PARK SERVICE	59,924	---		NOT AVAILABLE AT PRESENT TIME							

ALL WATER POTENTIAL DATA EXCERPTED FROM "SUMMARY OF POTENTIAL PROJECTS IN MONTANA, INVENTORY SERIES NO. 9, MONTANA WATER RESOURCES BOARD, JUNE 1969."

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No development activities, which would threaten their values, will be permitted until administrative study or legislative action determines the areas acceptability or unacceptability for classification and management as Wilderness.

These potential areas are subject to the same management constraints and depreciative actions as those presently within the Wilderness Preservation System.

Areas Being Considered for Possible Inclusion in the Wilderness Preservation System Within the Study Area (Appendix E, Plate 5.)

1. Cloud Peak Primitive Area - Bighorn National Forest - has been managed by the Forest Service since 1932. This area includes the central portion of the Bighorn Mountain Ranges and lies within the Bighorn National Forest. There are nearly a million people living within a 300-mile radius of the area. The area currently receives over 52,000 visitor-days use per season.

   Topography is very rough and includes the hydrographic divide of the Bighorn Mountain Range. Canyons and deep, narrow valleys drain easterly and westerly from this divide. Sheer granite walls and cirques are common. The lower portions of the area have more moderate slopes interspersed by rocky ridges and numerous drainages. Elevations are from 5,400 feet to 13,167 feet. Conifer forests, with small meadows and peaks, cover approximately 60 percent of the area. Water yield from the area is estimated at 600,000-acre feet/year.

The east side of the area has the potential to increase water yields 15 percent annually by the manipulation of vegetation.

The present proposal includes 150,490 acres of National Forest lands to be included in the National Forest Wilderness Preservation System.

2. Theodore Roosevelt National Memorial Park - 28,335 acres of the north and south units of the Theodore Roosevelt National Memorial Park are being considered for inclusion in the Wilderness Preservation System. The total area of the Park is over 70,000 acres. The area included in the proposal is available and suitable as Wilderness.

This Park consists of three separate units located on the Little Missouri River in western North Dakota. The primary historical resource of the Park is Theodore Roosevelt's association with the badlands and the open-range cattle frontier of the 1880's. The dominant natural resource is the badlands topography where wind and water have eroded the land into an infinite variety of sharp buttes, table lands, steep-walled canyons and gulches. This combination with its variety of soils results in several plant communities including grasslands, woodlands, and semi-arid cactus and yucca. Wildlife species include bison, antelope, bighorn sheep and wild horses. A number of endangered species such as the prairie falcon, ferruginous hawk and bald and golden eagles depend on the environment currently associated with the park management.

3. Charles M. Russell National Wildlife Range - The Bureau of Sport Fisheries and Wildlife is considering for study 175,000-275,000 acres of this 587,686-acre wildlife range as to its possible inclusion in the National Wilderness Preservation System. Most of the original river flood plain in the study area is now covered with water from the Fort Peck Reservoir. The area appears to have high potential as Wilderness.

The great Pleistocene glacier which spread over what is now northern Montana forced the Missouri River from its original channel to cut a new channel along the southern edge of the ice shield. As the glacier receded, newly formed streams eroded steep-walled coulees which formed extremely rough terrain bordering the present reservoir. The break land is unique, picturesque, and colorful, and still subject to forces of erosion.

Even though the area has in the past felt the "hand of man," increased use of the area could very well despoil the wilderness values of this unique area.

4. Lost Wood Wildlife Range - The Bureau of Sport Fisheries and Wildlife has proposed 5,486 acres of this 26,747-acre wildlife refuge for inclusion in the Wilderness Preservation System. This area, near the Canadian border, is subject to great extremes in climate.

This area is located in pothole country of the "Coteau du Missouri." The potholes were formed in the terminal moraine by melting of great blocks of ice broken from the receding glacier. Glacial drift is heavy and no outcroppings of bedrock are present. Grassy hills seem to roll on in endless confusion, which characterizes the Altamont Moraine formed by the Dakota lobe of the Wisconsin ice sheet. Evidence of man is substantially unnoticeable.

5. Medicine Lake National Wildlife Refuge - The Bureau of Sport Fisheries and Wildlife has proposed for inclusion in the National Wilderness Preservation System, 11,850 acres of the 31,457-acre wildlife refuge located in Sheridan and Roosevelt Counties in Montana. The climate of this area is extreme; however, the area is used intensively as a breeding ground for waterfowl, shore birds, and colonial nesting birds.

The area is gently rolling to flat, with Medicine Lake located in one of the prehistoric beds of the Missouri River. The lake is natural, but due to long-term erosion at the outlet, a water control structure was

constructed to maintain the normal lake level. There are six watersheds surrounding Medicine Lake which provide sufficient water for refuge impoundments which comprise over 13,000 acres of water and marsh.

While several areas within the study area have been identified as having potential for inclusion in the National Wilderness Preservation System, there remain many lands that may be both suitable and available for inclusion. This inventory in no way reflects the total land area which has wilderness potential. It will take much effort by agencies to identify and study those areas which seem to have high potential as Wilderness or for other administrative actions directed to preserve their natural environment.

Inventoried Wild Land Within the Study Area (Appendix E, Plate 5). The wild land resource has both cultural and physical implications. Wild lands are a part of our American heritage. They typify a way of life for many in this part of the country. The true value of such a resource can only be dealt with in subjective terms. Development has progressed slowly in this region, and the value of the wild land resource may never be apparent until it is totally lost.

The stewardship of the region is complex. Existing inventories that have considered wild lands are almost non-existent. This profile is, at best, cursory and identifies only the most apparent areas of wild lands.

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Table 4 -- AREA OF INVENTORIED WILD LANDS
WITHIN THE STUDY AREA

Managing Agency	State	County	ACRES Federal	State	Private	Total
USDA Forest Service	MT	Rosebud	21,946		200	22,146
		Powder River	26,765		1,710	28,475
		Golden Valley	17,736			17,736
	ND	McKenzie	236,900	11,840	17,060	265,800
		Golden Valley	40,990	7,440	7,620	56,050
		Slope	34,314	1,280	4,660	40,254
		Billings	159,676	17,700	18,200	195,576
	WY	Johnson	98,410			98,410
		Sheridan	124,817			124,817
TOTAL			761,554	38,260	49,450	849,264
Bureau of Land Management	MT	Valley	55,360	2,560	1,860	59,780
		Garfield	17,840	1,200	2,480	21,520
		Golden Valley	6,149			6,149
		Prairie	27,640	1,880	2,840	32,360
	WY	Johnson	56,550	9,600	31,480	97,630
		Campbell	25,000	2,600	15,440	43,040
TOTAL			188,539	17,840	54,100	260,479
National Park Service	ND	Billings	27,250			27,250
Bureau of Indian Affairs	MT	Bighorn	1,089,300			1,089,300
		Rosebud	74,900			74,900
		Yellowstone	19,800			19,800
		Valley	151,700			151,700
TOTAL			1,335,700			1,335,700
GRAND TOTAL - ALL FEDERAL MANAGEMENT			2,313,043	56,100	103,550	2,472,693
North Dakota State Forest	ND	Bottineau		5,400	320	5,720
Montana State Dept. of Lands	MT	Bighorn		9,878		9,878
		Carter		26,574		26,574
				36,452		36,452
GRAND TOTAL UNDER STATE MANAGEMENT				41,852	320	42,172
GRAND TOTAL - ALL MANAGEMENT			2,313,043	97,952	103,870	2,514,865

There are within the study area 2,313,043 acres managed by Federal agencies and 41,852 acres managed by State agencies that are in a wild land condition. Individual descriptions of these areas appear in Table 5 of this report.

These wild lands contain unusual landscapes, ranging from wide-open prairies, rough broken "badlands," to forested mountains. They receive large variations in seasonal precipitation. Since the 1880's, ranching has been the principal activity. The mores and customs of early-day ranching are deeply rooted in the local people. Wild lands provide habitat for wildlife and the open-space requirements of people.

In recent years, the discovery of coal, oil, and gas deposits has created a new interest in this area. Local residents and outside interests are viewing these lands with a new perspective. With the development of the energy resources, new population centers will come into existence. Increased populations, with their developmental demands, will change, in part, the wild land characteristic of the area.

Use conflicts will occur between mining, grazing, wildlife, existing recreation opportunities, and water use. These conflicts must be resolved in a manner which will serve most of the people and still protect the basic resources from deterioration by overuse.

Because of the nature and value of the wild land resource, a longer term study aimed at further inventory of the wild land resource is necessary. This inventory should develop the value which would be foregone in the event development is realized.

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Table 5--WILD LANDS WITHIN STUDY AREA

MANAGING AGENCY	MAP INDEX #	AREA NAME	STATE	COUNTY	ACRES FEDERAL	ACRES STATE	ACRES PRIVATE	TOTAL	DESCRIPTION AND QUALITY INDEX
USDA-FOREST SERVICE	1	BLUE BUTTES	ND	MCKENZIE	2,400			2,400	AN AREA OF UNIQUE ECOLOGICAL SIGNIFICANCE WITHIN THE DISTRICT. AREA RECEIVES APPROX. 17 INCHES OF RAINFALL PER YR., CONTAINS A SERIES OF BUTTES UPLIFTED FROM THE SURROUNDING PLAINS, AND HAS HARDWOOD DRAWS CONTAINING OAK, ELM, ASH AND OTHER SPECIES OF LARGER THAN AVERAGE SIZE FOR THIS PART OF NORTH DAKOTA. (QUALITY INDEX OF 151 REPRESENTS AVERAGE FOR ALL NATIONAL GRASSLANDS)
	2	BURNT CREEK	ND	MCKENZIE	9,800	300	1,800	11,900	CONSISTING PRIMARILY OF EXTREMELY ROUGH REMOTE BADLANDS WITH SOME FLAT HIGH BENCH LAND ALONG THE NORTHERN PART AND RIVER BOTTOM LAND ON THE SOUTHERN EDGE. SIGNIFICANT MULE DEER HUNTING AREA. (151)
	3	ROUGH CREEK	"	"	8,800	200		9,000	ROUGH BADLANDS, SIGNIFICANT MULE DEER HUNTING AREA. RANGE ON SOUTH END HAS OVERUSE PROBLEMS. AVERAGES APPROXIMATELY FAIR IN CONDITION. (151)
	4	SOUTH CARTWRIGHT	"	"	6,700	100		6,800	CONSISTS PRIMARILY OF UPLAND OPEN GRASS BENCHES. HAS SIGNIFICANT ACREAGE OF SEEDED CRESTED WHEATGRASS. GOOD ANTELOPE RANGE. SOUTH THREE-QUARTERS OF AREA UNDER INTENSIVE RANGE MANAGEMENT SYSTEM. (151)
	5	W. BRANCH CHARBONNEAU CREEK	"	"	9,800	300		10,000	OPEN ROLLING GRASSLANDS HEAVILY FARMED IN THE 20'S AND 30'S. SIGNIFICANT ACREAGES OF CRESTED WHEATGRASS. CONTAINS PRAIRIE DOG TOWNS, OLD HOMESTEAD SITES, AND IS GOOD ANTELOPE RANGE. RANGE CONDITION GENERALLY GOOD. AREA UNDER INTENSIVE RANGE MANAGEMENT WITH ONE OBJECTIVE BEING TO RETAIN OPEN SPACE. POSSIBLE OUTDOOR LABORATORY FOR UND-WILLISTON CENTER

Table 5 (Cont'd)

USDA-FOREST SERVICE (CONTINUED)	6	HORSE CREEK	ND	MCKENZIE	14,600	1,300		15,900	GRADES FROM OPEN ROLLING GRASSLANDS IN AREA NO. 5 TO MODERATELY INCISED ROLLING TOPOGRAPHY CONTAINING STEEP WALLED GULLIES, HEADWALLS, AND STRINGERS OF HARDWOOD DRAWS. CONTAINS LARGEST KNOWN PRAIRIE DOG TOWN ON DISTRICT (102 ACRES) AND A PETRIFIED FOREST. GOOD ANTELOPE RANGE. POSSIBLE OUTDOOR LAB FOR UND-WILLISTON CENTER. THERE ARE INDICATIONS THAT THE BLACK-FOOTED FERRET MAY INHABIT THE AREA AROUND THE PRAIRIE DOG TOWN. (151)
	7	CHANEY CREEK	"	"	12,800	640	80	13,520	ROUGH UPLAND BADLANDS TOPOGRAPHY. GOOD MULE DEER COVER. CONTAINS INDIAN VILLAGE SITES. (151)
	8	LOWER BENNIE PIERRE CREEK	"	"	17,400	300	160	17,860	MODERATELY TO STEEPLY ROLLING GRASSLAND ON EAST END GRADING INTO SHARPLY DEFINED UPLAND BADLAND TOPOGRAPHY IN WESTERN HALF. CONTAINS MULE DEER, WHITETAIL, AND ANTELOPE HABITAT. RANGE IN FAIR TO GOOD CONDITION IN NORTH HALF AND POOR TO FAIR IN SOUTH HALF. HAS HAD SOME OIL WELL DEVELOPMENT IN PAST. NO PRODUCING WELLS. (151)
	9	BENNIE PIERRE-BOWLINE	"	"	24,200	640		24,840	UPLAND BADLANDS ON EAST WITH PETRIFIED WOOD AREAS AND GOOD BIG GAME HABITAT GRADING FROM MODERATELY TO STEEPLY SLOPING OPEN GRASSLANDS ON WEST. AREA CONTAINS SOME PAST OIL DEVELOPMENT. NO ACTIVE OIL PRODUCTION AT PRESENT. WESTERN HALF OF AREA IS CONTAINED IN DETAILED NORTH-SOUTH STUDY. MAJOR NORTH-SOUTH PAVED HIGHWAY PROPOSAL LIKELY FOR AREA. (151)
	10	BOWLINE CREEK	"	"	7,400	300		7,700	ROLLING UPLAND GRASSLAND GRADING INTO MODERATELY INCISED BOWLINE CREEK ON SOUTHERN EDGE. CONTAINS ISOLATED BUTTES. (151)

Table 5 (Cont'd)

USDA-FOREST SERVICE (CONTINUED)	11	REDWING CREEK	ND	MCKENZIE	7,000	400	4,200	11,600	VERY ROUGH BADLANDS TOPOGRAPHY SPRINKLING A MEANDERING STEEP WALLED CREEK. STEEP DRAWS WELL WOODED WITH JUNIPER CONTAINS PETRIFIED WOOD AREAS. (151)
	12	BEAR-FRENCH CR.	"	"	9,800	640	960	11,400	A PORTION OF THE MAIN LITTLE MISSOURI BADLANDS. A REMOTE LITTLE VISITED AREA WITH DEEPLY INCISED BADLANDS DRAINING TO THE LITTLE MISSOURI RIVER. A HEAVILY HUNTED AREA FOR MULE DEER. NORTH AND EAST SLOPES ARE COVERED WITH GOOD STANDS OF MIXED JUNIPER-HARDWOODS. AN AREA OF SIGNIFICANT BEAUTY. AREA CONTAINED IN NORTH-SOUTH STUDY. CONTAINS SIGNIFICANT PETRIFIED WOOD AREAS. (151)
	13	CINNAMON-PRAIRIE DOG	"	"	20,400	1,600	4,300	26,300	AREA ALONG CINNAMON CREEK COMPARES TO AREA NO. 12. PRAIRIE DOG CREEK AREA IS MORE OPEN BADLANDS TYPE MADE HIGHLY INACCESSIBLE BY STEEP WALLED GULLIES. RANGE ON SOUTH END IN GENERALLY FAIR CONDITION. AREA CONTAINED IN NORTH-SOUTH STUDY. (151)
	14	PASTURE 8 WEST	"	"	7,100	640		7,740	PORTION OF MAIN LITTLE MISSOURI BADLANDS. DRAINAGES TRENDING NORTH WITH VERY ROUGH TOPOGRAPHY. NORTH AND EAST SLOPES WELL COVERED WITH MIXED HARDWOOD-JUNIPER TYPES. HEAVILY HUNTED MULE DEER AREA. RANGE UNDER INTENSIVE MANAGEMENT, BUT WITH DEFINITE PROBLEMS STILL EXISTING. RANGE IN FAIR TO LOW FAIR CONDITION. (151)
	15	CORRAL CREEK	"	"	2,400			2,400	AREA CONTIGUOUS AND SIMILAR TO AREA NO. 14 EXCEPT FOR INTERVENING ROAD CORRIDOR. CONTAINS INDIAN LODGE SITES. (151)

Table 5 (Cont'd)

USDA-FOREST SERVICE (CONTINUED)	16	LONE BUTTE	ND	MCKENZIE	13,000	600	160	13,760	EXTREMELY ROUGH BADLANDS TOPOGRAPHY BRACKETING THE HEADWATERS OF DRY CREEK. NORTH AND EAST SLOPES WELL WOODED WITH MIXED HARDWOOD-JUNIPER. CONTAINS RELATIVELY RARE COUNTY STANDS OF BUR OAK AND ASPEN. AREA UNDER INTENSIVE RANGE MANAGEMENT PLAN. AREA STILL HAS SERIOUS RANGE PROBLEMS. CONSIDERED ONE OF THE PRIME AREAS TO BE RECOMMENDED FOR ROADLESS DESIGNATION. ACCESS IS LIMITED TO THE WESTERN PART WHICH BORDERS THE HIGHWAY AND PORTIONS OF THE NORTHERN BOUNDARY. (151)
	17	BENNET CREEK	"	"	20,100	1,300	1,800	23,200	UPLAND GRASSLAND AT EXTREME EAST END GRADING INTO EXTREMELY ROUGH BADLANDS TOPOGRAPHY. PRIME MULE DEER HUNTING AREA. RANGE IN FAIR CONDITION. (151)
	18	BUMMER CREEK	"	"	5,900			5,900	EXTREMELY ROUGH BADLANDS TOPOGRAPHY. HAS HAD SOME OIL WELL DEVELOPMENT IN PAST. NO ACTIVE PRODUCERS. RANGE IN FAIR CONDITION. AREA PRACTICALLY INACCESSIBLE TO FOUR-WHEEL VEHICLES. HEAVILY HUNTED FOR MULE DEER. (151)
	19	ICE BOX CANYON	"	"	8,300	800	1,500	10,600	AREA SIMILAR TO AREA NO. 18 EXCEPT SLOPING LARGELY TO SOUTH AND WEST. HAS SIGNIFICANT PETRIFIED WOOD AREAS IN IT. (151)
	20	BEICEGEL CREEK	"	"	11,000	640	2,100	13,740	ROUGH BADLANDS STRADDLING BEICEGEL CREEK. AREA HAS NUMEROUS SCENIC BUTTES. AREA IS ONE OF MOST REMOTE PORTIONS OF THE DISTRICT. GOOD MULE DEER HABITAT. IS THE EDGE OF THE RANGE FOR ONE OF THREE MOUNTAIN SHEEP HERDS IN NORTH DAKOTA. (151)

Table 5 (Cont'd)

USDA-FOREST SERVICE (CONTINUED)	21	MAGPIE CREEK	ND	MCKENZIE	17,000	640		17,640	THIS IS THE MOST SIGNIFICANT AREA SIZE-WISE AND IN REMOTENESS FOR ROADLESS POSSIBILITIES ON THE DISTRICT. IT IS CONTIGUOUS TO A LARGE AREA TO THE SOUTH ON THE MEDORA DISTRICT. THE COUNTRY CONSISTS OF EXTREMELY ROUGH BADLANDS STRADDLING A LARGE FLAT BOTTOM DRAINAGE (MAGPIE CR.). THE AREA CONTAINS THE MAIN HABITAT FOR ONE OF THREE MOUNTAIN SHEEP HERDS IN THE STATE. IT IS GOOD MULE DEER COUNTRY AS WELL AS CONTAINING NESTING AREAS FOR GOLDEN EAGLES. IT CONTAINS SIGNIFICANT PETRIFIED WOOD AREAS. RANGE CONDITION ON THE WEST END IS IN POOR TO FAIR CONDITION. REMAINING RANGE IS IN GENERALLY FAIR TO GOOD CONDITION. (151)
	22	WHITETAIL CR.	"	BILLINGS	36,060	1,240	2,200	39,500	THIS AREA HAS LARGE AREAS OF ROUGH BADLANDS INTERMINGLED WITH GRASSLANDS WITH OPEN SPACE VALUES. MAIN USE OF THIS AREA IS DISPERSED RECREATION, WILDLIFE, AND SUMMER RANGE FOR CATTLE. PART OF THE AREA IS IN COMMUNITY PASTURE AND PART IS PRIVATELY ALLOCATED WITH PART OF THIS AREA UNDER INTENSIVE GRAZING MANAGEMENT. THIS AREA CONTAINS ARCHAEOLOGICAL SITES AND MANY PETRIFIED TREES. MOST OF THE MINERAL RIGHTS ARE HELD BY THE UNITED STATES FOREST SERVICE AND THE MINERALS ARE UNDER LEASES LIMITED TO 10 YRS. OR LESS. ONE OF THE MOST SIGNIFICANT ROADLESS AREAS, IN TERMS OF SIZE, IN THE ENTIRE GRASSLANDS. (151)
	23	UPPER MAGPIE CR.	"	BILLINGS MCKENZIE	6,490	1,140	640	8,270	THIS AREA HAS SMALL AREAS OF BADLANDS WITH OPEN SPACE VALUES. MAIN USE OF THIS AREA IS DISPERSED RECREATION, WILDLIFE, AND SUMMER RANGE FOR CATTLE. IT IS PART OF A COMMUNITY PASTURE AREA. MOST OF THE MINERAL RIGHTS ARE HELD BY THE UNITED STATES FOREST SERVICE AND THE MINERALS ARE UNDER LEASE LIMITED TO 10 YRS. OR LESS TENURE. (151)

Table 5 (Cont'd)

USDA-FOREST SERVICE (CONTINUED)	24	BELL LAKE	ND	GOLDEN VALLEY	13,190	640	320	14,150	THIS AREA HAS SMALL AREAS OF BADLANDS WITH DEEP GULLIES, WITH THE REMAINDER OF THE AREA BEING GRASSLANDS WITH OPEN SPACE VALUES. MAIN USE OF THIS AREA IS DISPERSED RECREATION, WILDLIFE, AND SUMMER RANGE. THE AREA IS A COMMUNITY GRAZING PASTURE WITH INTENSIVE GRAZING MANAGEMENT PLANNED. THERE ARE ARCHAEOLOGICAL SITES IN THE AREA. MOST OF THE MINERAL RIGHTS HELD BY THE UNITED STATES FOREST SERVICE AND ARE UNDER LEASES LIMITED TO 10 YRS. OR LESS. (151)
	25	ROOSEVELT CR.	"	BILLINGS GOLDEN VALLEY	11,800	1,280	1,920	14,560	THIS AREA HAS SMALL AREAS OF BADLANDS WITH ROUGH BROKEN GRASSLAND AREAS WITH OPEN SPACE VALUES. MAIN USE OF THIS AREA IS DISPERSED RECREATION, WILDLIFE, AND SUMMER RANGE FOR CATTLE. THE AREA CONTAINS A DEER STUDY AREA FOR NORTH DAKOTA GAME AND FISH DEPARTMENT. THE BURLINGTON NORTHERN INC. OWNS THE MINERALS UNDER SIX SECTIONS OF THE UNITED STATES FOREST SERVICE LAND. (151)
	26	MIKE CREEK-ASH COULEE	"	BILLINGS	37,740	2,560	5,720	46,020	THIS AREA HAS A LARGE AREA OF ROUGH BROKEN BADLANDS WITH AREAS OF ROUGH BROKEN GRASSLANDS AND ROLLING GRASSLANDS ALL WITH OPEN SPACE VALUES. MAIN USE OF THIS AREA IS DISPERSED RECREATION, WILDLIFE, AND SUMMER RANGE FOR CATTLE. PART OF THE AREA IS IN A COMMUNITY PASTURE. THIS AREA CONTAINS ARCHAEOLOGICAL SITES AND MANY PETRIFIED TREES. MOST OF THE MINERAL RIGHTS ARE HELD BY THE UNITED STATES FOREST SERVICE AND THE MINERALS ARE UNDER LEASE LIMITED TO 10 YRS. OR LESS. A NORTH-SOUTH RECREATIONAL ROAD IS BEING STUDIED BY THE FOREST SERVICE FOR FEASIBILITY FOR CONSTRUCTION. IF CONSTRUCTED, THIS ROAD WOULD BE AN IMPACT, BUT WOULD ELIMINATE ONLY A SMALL ACREAGE FROM THE ROADLESS AREA POSSIBILITY. (151)

Table 5 (Cont'd)

USDA-FOREST SERVICE (CONTINUED)	27	LOWER WANNAGAN CR.	ND	BILLINGS	12,240	2,320	1,040	15,600	THIS IS AN AREA OF MOSTLY GRASSLANDS WITH SOME BADLANDS WHICH CONTAIN ROUGH BROKEN AREAS ALONG PREDOMINENT DRAINAGES WITH OPEN SPACE VALUES. MAIN USE OF THIS AREA IS DISPERSED RECREATION, WILDLIFE, AND SUMMER RANGE FOR CATTLE. THE BURLINGTON NORTHERN INC. CONTROLS THE MINERALS UNDER 3,800 ACRES OF FOREST SERVICE LAND IN THIS AREA. (151)
	28	TWIN BUTTE	"	BILLINGS GOLDEN VALLEY	10,350	3,760	320	14,430	THESE ARE GRASSLAND AREAS WITH PREDOMINENT BADLAND FORMATIONS. MAIN USE OF THIS AREA IS DISPERSED RECREATION, WILDLIFE, PALEONTOLOGICAL EXPLORATION, AND SUMMER RANGE FOR WILDLIFE. PALEONTOLOGICAL AREAS HAVE BEEN PARTIALLY EXCAVATED. THERE IS EVIDENCE OF INDIAN ARCHAEOLOGY. (151)
	29	TRACY MTN.	"	BILLINGS	15,940	960		16,900	OPEN GRASSLAND AREAS PREDOMINENT HERE. MAIN USE OF THIS AREA IS DISPERSED RECREATION, WILDLIFE, AND SUMMER RANGE FOR CATTLE. IT IS A HISTORICAL AREA. A BUREAU OF RECLAMATION TRANSMISSION LINE CROSSES A PART OF THE AREA. AN OIL WELL HAS BEEN LOCATED ON ONE SECTION IN THE NORTHERN PART OF THE AREA. (151)
	30	BEACON	"	GOLDEN VALLEY	7,620	3,600	6,980	18,200	THERE ARE LARGE AREAS OF GRASSLAND RIDGES TOPPED WITH RED SCORIA ROCK WITH OPEN SPACE VALUES. MAIN USE OF THIS AREA IS DISPERSED RECREATION, WILDLIFE, AND SUMMER RANGE FOR CATTLE. THE AREA IS BEING MANAGED UNDER PRIVATE ALLOTMENTS WITH THE INDIVIDUAL PERMITTEES GIVING MUCH VALUE TO THE OPEN SPACE CONCEPT. (151)
	31	BEAR CREEK	"	BILLINGS	18,460	1,820		20,280	THERE IS A LARGE AREA OF GRASSLANDS AND BADLANDS BROKEN BY NUMEROUS RAVINES AND ACTIVELY CUTTING GULLIES. THE MAIN USE OF THE AREA IS DISPERSED RECREATION, WITH OPEN SPACE VALUES, WILDLIFE, AND SUMMER RANGE FOR CATTLE. (151)

Table 5 (Cont'd)

USDA-FOREST SERVICE (CONTINUED)	32	PORTER PASTURE	ND	BILLINGS	7,940	640		8,580	THIS AREA IS GRASSLANDS WITH OPEN SPACE VALUES. THE MAIN USE OF THIS AREA IS DISPERSED RECREATION, WILDLIFE, WITH SPECIAL VALUES, SUCH AS EAGLE AND PRAIRIE DOG AREAS, AND SUMMER RANGE FOR CATTLE. THIS AREA IS A HISTORICAL AREA. (151)
	33	BULLION BUTTE	"	BILLINGS GOLDEN VALLEY SLOPE	19,100	1,440		20,540	THE AREA IS MOSTLY GRASSLANDS AND CONTAINS A VERY PREDOMINENT BUTTE WHICH IS RELATIVELY INACCESSIBLE. THE AREA HAS OPEN SPACE VALUES. THE MAIN USE OF THE AREA IS DISPERSED RECREATION, WILDLIFE, AND SUMMER RANGE FOR CATTLE. IT APPEARS THAT THE BUTTE IS AN IMPORTANT NESTING AREA FOR GOLDEN EAGLES. (151)
	34	BURNING COAL VEIN	"	SLOPE	6,190	320	1,440	7,950	THIS AREA IS MOSTLY GRASSLANDS WITH SMALL AREAS OF BADLANDS AND CONTAINS A COLUMBIAR JUNIPER STAND OF TREES. IT ADJOINS THE BURNING COAL VEIN WHICH IS A RECREATIONAL ATTRACTION. OTHER USE OF THE AREA IS FOR DISPERSED RECREATION WITH OPEN SPACE VALUES, WILDLIFE, AND CATTLE SUMMER RANGE. PART OF THIS AREA IS UNDER INTENSIVE RANGE MANAGEMENT. THE AREA IS IMPORTANT HISTORICALLY. THIS AREA IS ALSO UNDERLAIN BY WORKABLE COAL DEPOSITS. (151)
	35	PONDEROSA PINE AREA	"	"	6,900	320	160	7,380	THIS AREA IS GRASSLAND MIXED WITH A PONDEROSA PINE STAND. THE PINE IS NOT A COMMERCIAL STAND, BUT IS IMPORTANT HISTORICALLY AND AS A RECREATIONAL DISPERSED AREA. THIS IS PRACTICALLY THE ONLY STAND OF PONDEROSA PINE IN NORTH DAKOTA. THE AREA IS ALSO UNDERLAIN BY WORKABLE COAL DEPOSITS. THIS AREA IS RECEIVING QUITE HEAVY OFF-ROAD VEHICLE USE. MUCH OF THE PONDEROSA PINE STAND IS LOCATED OUTSIDE THE UNIT. (151)
	36	STROM-HANSEN	"	GOLDEN VALLEY SLOPE	16,770	640	2,740	20,150	THIS AREA IS GRASSLANDS WITH THE LITTLE MISSOURI RIVER RUNNING THROUGH THE AREA. MAIN USE OF THE AREA IS DISPERSED RECREATION WITH OPEN SPACE VALUES, WILDLIFE, AND SUMMER RANGE FOR CATTLE. (151)

Table 5 (Cont'd)

USDA-FOREST SERVICE (CONTINUED)	37	LIMBER PINES	ND	SLOPE	3,190		320	3,510	THE AREA CONTAINS THE ONLY KNOWN STAND OF LIMBER PINE TREES EAST OF THE SLOPES OF THE ROCKY MOUNTAINS. THE STAND OF TREES IS NOT COMMERCIAL, BUT IS A SPECIAL INTEREST AREA. MAIN USE OF THE AREA IS DISPERSED RECREATIONAL WITH OPEN SPACE VALUES, WILDLIFE, AND SUMMER RANGE FOR CATTLE. (151)
	38	PASTURE ONE SOUTH	"	BILLINGS	6,500	4,240	6,680	17,420	THIS AREA IS PRIMARILY GRASSLANDS WITH SOME BADLANDS AND BUTTES WITH RED SCORIA SUMMITS. THE MAIN USE OF THIS AREA IS DISPERSED RECREATION WITH OPEN SPACE VALUES, WILDLIFE, AND CATTLE GRAZING IN THE SUMMER MONTHS. THIS AREA HAS A RELATIVELY LARGE AREA OF SCHOOL LAND WHICH MAY BE PERMANENTLY MANAGED BY THE FOREST SERVICE. (151)
	39	BIG SNOWIES	MT	GOLDEN VALLEY	17,786			17,786	THIS IS PART OF AN 84,778-ACRE INVENTORIED ROADLESS AREA WHICH EXTENDS INTO FERGUS COUNTY. THE ENTIRE ROADLESS AREA IS DESCRIBED AS FOLLOWS: THERE ARE NO KNOWN ACTIVITIES IN THE SNOWIES THAT WILL ALTER THE AVAILABILITY OF THIS AREA. WATERSHED CONSIDERATIONS ON THE SPRING CREEK OR LEWISTOWN SIDE PROBABLY OFFER THE GREATEST LONG-RANGE VALUE. PRESSURES FOR COMMUNICATION POINTS CONTINUE; ONE EXISTS ON THE WEST END OF THE SNOWIES. THIS STRUCTURE IS SERVICEDVIA HELICOPTER. TIMBER VALUES ARE NOT FULLY KNOWN AT THIS TIME; THERE ARE NO SALES IN THE 5-YR. PLAN INCLUDED WITHIN THE ROADLESS AREA. (151)
	40a	CLOUD PEAK (PROPOSED WILDERNESS)	WY	JOHNSON SHERIDAN					(SEE PAGE 14 OF PROFILE NARRATIVE)
	40b	CLOUD PEAK (WILD AREA)	WY	JOHNSON SHERIDAN	98,956			98,956	THE ENTIRE AREA IS CONTIGUOUS TO THE CLOUD PEAK P.A. ELEVATIONS RANGE FROM 8,500 FEET TO OVER 10,000 FEET. NON-FORESTED AREAS CONSIST OF ALPINE AND SUB-ALPINE VEGETATION AND ARE CHARACTERIZED BY THIN GRANITIC SOILS WITH NUMEROUS ROCK OUTCROPS. (91)

Table 5 (Cont'd)

USDA-FOREST SERVICE (CONTINUED)	41	DRY FK. DRAINAGE	WY	SHERIDAN	44,117	44,117	THIS AREA RISES ABRUPTLY ALONG THE EAST FACE OF THE BIGHORN MTNS. AND IS CUT BY MANY CANYONS. THE HIGHER PORTIONS LIE IN THE MORE DENSE LODGEPOLE PINE-ENGELMANN SPRUCE-ALPINE FIR TIMBER TYPES. THESE SPECIES GIVE WAY TO THE DOUGLAS FIR TIMBER AND FINALLY TO PONDEROSA PINE. THERE ARE MANY GRASSY PARKS SURROUNDED BY CONIFEROUS TIMBER. THE AREAS BETWEEN THE DEEPLY CUT WATER COURSES ARE PLATEAU-LIKE. ACCESS INTO AND THROUGH THIS AREA IS VIA PACK AND JEEP TRAILS. FOUR GRAZING ALLOTMENTS LIE PARTLY OR WHOLLY WITHIN THE AREA. BIG GAME HABITAT IS BEING GIVEN HIGH PRIORITY; HOWEVER, NUMBER WILL BE CONTROLLED WHEN RESOURCE DAMAGE IS CAUSED. SOME COMMERCIAL TIMBER HARVEST ON RIDGES AND PLATEAUS FROM LICK CREEK TO GARLAND GULCH AND NEAR THE HEAD OF EAST PASS CREEK IS PLANNED. METHOD WILL BE EMPLOYED TO PROTECT ESTHETICS AND RESTORE HARVESTED AREAS TO TIMBER PRODUCTION. (150)
	42	TONGUE RIVER	"	"	15,100	15,100	THIS AREA IS LOCATED AROUND TONGUE RIVER CANYON FROM THE FOREST BOUNDARY TO THE TWIN BUTTE AREA. THE STEAMBOAT POINT AREA IS THE SOUTHERN END AND FREEZEOUT STOCK DRIVEWAY THE NORTHERN. DENSE CONIFEROUS TIMBER STANDS ARE MOSTLY RESTRICTED TO THE STEEP NORTHERN EXPOSURES, WHILE THE MAJORITY OF THE AREA IS TYPIFIED BY MANY OPEN PARKS AND SCATTERED TIMBER STANDS. A BACK AREA RECREATIONAL EXPERIENCE AS PERTAINS TO HUNTING, FISHING, CAMPING, SIGHTSEEING, NATURE STUDY, AND GENERAL ENJOYMENT IS OFFERED TO THE PUBLIC WITHIN 25 MILES OF SHERIDAN, WYOMING. THREE GRAZING ALLOTMENTS ARE WITHIN THE AREA. MAN-MADE IMPROVEMENTS INCLUDE 3 MILES OF IRRIGATION DITCH, 15 MILES OF ROADS AND TRAILS, SEVERAL STOCKPONDS AND RELATED WATER DEVELOPMENTS, 8 MILES OF FENCE, AND A TRAIL BRIDGE. (126)

30

Table 5 (Cont'd)

USDA-FOREST SERVICE (CONTINUED)	43	WALKER PRAIRIE	WY	SHERIDAN	55,000	55,000	BECAUSE OF ELEVATION, RELIEF, AND EXPOSURE, THIS AREA IS TYPICAL OF MOST OF THE EAST FACE OF THE BIGHORNS IN THAT IT FORMS PRIME BIG GAME HABITAT. LARGE OPEN PARKS WITH ASPEN AND OTHER BROWSE SPECIES ARE PREVALENT IN THE LOWER REACHES OF THIS UNDEVELOPED AREA. IT ARISES ABRUPTLY AND IS CUT BY MANY CANYONS. MANY OF THESE WATER COURSES ARE INTERMITTENT STREAMS. (85)
	44	GRUMMOND CREEK	"	JOHNSON	8,452	8,452	BORDERED ON THE WEST BY SOUTH FORK OF CLEAR CREEK, NORTH BY MIDDLE FORK OF CLEAR CREEK AND GROUSE MOUNTAIN RIDGE, EAST BY THE FOREST BOUNDARY, AND ON SOUTH AND SOUTHWEST BY ELGIN PARK AND DRAINAGE DIVIDES, THE AREA IS PRIMARILY LODGEPOLE PINE INTERSPERSED WITH AREAS OF PONDEROSA PINE. DRIER SIDEHILLS SUPPORT IDAHO FESCUE, WHILE THE BOTTOMS SUPPORT CAREX AND BLUEGRASS TYPES. THERE ARE SOME SMALL PATCHES, GENERALLY IN THE VICINITY OF THE WEST AND SOUTH BOUNDARY, THAT WERE HARVESTED FOR TIMBER 80 TO 100 YEARS AGO. A PATENTED MINING CLAIM IS LOCATED WITHIN THE AREA. THE REMAINS OF AN OLD IRRIGATION DITCH ARE PRESENT IN THE AREA; HOWEVER, IT NEVER CARRIED WATER AND HAS SINCE GROWN BACK TO TIMBER. RANGE FENCES FOR THE MANAGEMENT OF LIVESTOCK ARE PRIMARILY ALONG THE SOUTHWEST AND EAST SIDES OF THE AREA. THERE ARE TWO RESERVOIRS, TWO SPRING DEVELOPMENTS, AND A COW CAMP LOCATED WITHIN THE AREA (T. 50N., R. 89W.). THE LACK OF EASY ACCESS, AVAILABLE FISHING WATER, AND DENSE TIMBER STANDS PROHIBITS MAJOR RECREATION USE EXCEPT BY HARDY HUNTERS IN THE FALL. (124)
	45	DOYLE-TAYLOR CR.	"	"	6,875	6,875	THIS AREA, PRIMARILY A LODGEPOLE PINE TYPE INTERSPERSED WITH GRASSY BOTTOMS COMPOSED OF SEDGES, BLUEGRASS, AND CAREX, IS BORDERED ON THE WEST BY HAZELTON ROAD, ON THE SOUTH AND EAST BY THE FOREST BOUNDARY; AND ON THE NORTH BY THE LOWER DOYLE CAMPGROUND ROAD AND A LINE RUNNING EAST FROM THE ROAD TO THE FOREST BOUNDARY. APPROX. 9½ MILES OF FOREST BOUNDARY FENCE ARE LOCATED ON THE EAST, SOUTH, AND NORTH SIDE OF THE UNDEVELOPED AREA. APPROX. 2 MILES OF JEEP AND WAGON TRAILS, CONSTRUCTED AS ACCESS FOR TRAILING SHEEP, ARE IN THE

Table 5 (Cont'd)

USDA-FOREST SERVICE (CONTINUED)	45 (CONTINUED)								AREA. RECREATION USE WITHIN THE AREA IS LIMITED TO A FEW ACCESSIBLE AREAS ALONG HAZELTON ROAD AND AROUND LOWER DOYLE CAMPGROUND. FISHING IS THE MAJOR APPARENT USE AND IS CONCENTRATED ALONG DOYLE CREEK. (106)
	46		MT	POWDER RIVER	13,220		1,550	14,770	NOT AVAILABLE AT PRESENT TIME
	47		"	ROSEBUD	18,976		200	19,176	"
	48		"	POWDER RIVER ROSEBUD	13,055		160	13,215	"
	49		"	POWDER RIVER	8,460			3,460	"
NATIONAL PARK SERVICE	1	NORTH UNIT, THEODORE ROOSEVELT NATIONAL MEMORIAL PARK	ND	MCKENZIE					(SEE PAGE OF PROFILE NARRATIVE)
	2a	SOUTH UNIT, THEODORE ROOSEVELT NATIONAL MEMORIAL PARK (PROPOSED WILDERNESS)	"	BILLINGS					"
	2b	SOUTH UNIT, THEODORE ROOSEVELT NATIONAL MEMORIAL PARK (WILD AREA)	"	"	27,250			27,250	NOT AVAILABLE AT PRESENT TIME (164)
STATE - NORTH DAKOTA	1	TURTLE MTN. STATE RECREATION FOREST	"	BOTTINEAU		5,400	320	5,720	NOT AVAILABLE AT PRESENT TIME
STATE - MONTANA	2	AREA NO. 1	MT	BIG HORN		9,878		9,878	" (115)
	3	AREA NO. 2	"	CARTER		26,574		26,574	" (96)
BUREAU OF SPORT FISHERIES AND WILDLIFE	1	CHARLES M. RUSSELL NATIONAL WILDLIFE RANGE	"	GARFIELD MCCONE VALLEY					(SEE PAGE 16 OF PROFILE NARRATIVE)
	2	LOSTWOOD WILDERNESS PROPOSAL	ND	MOUNTRAIL BURKE					(SEE PAGE 16 OF PROFILE NARRATIVE)
	3	MEDICINE LAKE WILDERNESS PROPOSAL	MT	SHERIDAN ROOSEVELT					(SEE PAGE 16 OF PROFILE NARRATIVE)

Table 5 (Cont'd)

BUREAU OF LAND MANAGEMENT	1	BURNT LODGE ROADLESS AREA	MT	VALLEY	6,720	640	640	8,000	THE LAND HILLS AREA OF WHICH THE BURNT LODGE ROADLESS AREA IS A PART OF IS IN A NEAR PRIMITIVE STATE DUE TO THE RUGGED, NEARLY INACCESSIBLE TERRAIN. THE AREA PROVIDES IDEAL PROTECTION TO BIG GAME ANIMALS. ITS CANYONS ARE BREATHTAKINGLY STEEP AND DEEP. RECREATIONISTS WISHING TO ENTER THE AREA TO HUNT, CAMP, SIGHTSEE, CLIMB, OR PHOTOGRAPH THE SCENIC SPLENDOR WILL FIND THIS A CHALLENGING AREA OF RUGGED BEAUTY. A FEW FAINT JEEP TRAILS PROVIDE ACCESS INTO THE AREA; FOUR-WHEELED VEHICLES ARE REQUIRED FOR TRAVEL. THE ONLY PERMANENT IMPROVEMENTS IN THE AREA ARE AN ABANDONED HOMESTEAD SHACK (ON PRIVATE LAND) AND A LIVESTOCK MANAGEMENT FENCE. (153)
	2	C. M. RUSSELL WILDLIFE RANGE	"	"	48,640	1,920	1,220	51,780	THIS AREA LIES ADJACENT TO THE FORT PECK RESERVOIR AND IS WITHIN THE MISSOURI RIVER BREAKS COUNTRY. (SEE PAGE 10 OF NARRATIVE FOR ADDITIONAL DATA) (89)
	3	FORTIFICATION CREEK AREA	WY	JOHNSON CAMPBELL	50,000	10,000	40,000	100,000	THE CONTROLLING TOPOGRAPHIC FEATURE OF THIS AREA IS THE POWDER RIVER BREAKS (ELEVATION 3,500-4,500 FEET). THIS "BADLAND" TYPE TERRAIN, COMPOSED OF SOFT SHALES AND SANDSTONES, HAS BEEN CARVED INTO AN AREA OF INTRICATELY DISSECTED SURFACES OF STEEP, RAW SLOPES; EXTENDED ESCARPMENTS; SHARP RIDGES; BUTTES; PINNACLES; AND VERTICAL-WALLED GULLIES. THE "BREAKS" ARE SO THOROUGHLY BROKEN AND DISSECTED AS TO HAMPER ACCESS BY HORSEBACK AND SEVERLY RESTRICT USE OF VEHICLES. THE SOILS ARE EXTREMELY SUSCEPTIBLE TO EROSION. SIGNIFICANT PROTECTIVE VEGETATIVE COVER HAS NEVER BEEN ALLOWED TO DEVELOP DUE TO THE STERILE NATURE OF THE PARENT MATERIALS AND STEEPNESS OF THE GRADES. CULTURAL FEATURES OR MAN-MADE STRUCTURES ARE FEW AND LIMITED TO LIVESTOCK FENCES, WATER WELLS, RESERVOIRS, CORRALS, AND REMNANTS OF HOMESTEADS (AS WELL AS ABANDONED OIL AND GAS EXPLORATION HOLES). A FEW JEEP TRAILS TRANSECT THE AREA AND ARE IN VARIOUS STATES OF POSSIBILITY, DEPENDING UPON WEATHER CONDITIONS AND DETERIORATION. WILDLIFE SPECIES IN THE AREA INCLUDE ABUNDANT MULE DEER, ELK, ANTELOPE, COYOTES, EAGLES, RABBITS, PRAIRIE DOGS, SAGE AND SHARP-TAILED GROUSE, GRAY AND CHUKAR PARTRIDGES,

Table 5 (Cont'd)

BUREAU OF LAND MANAGEMENT (CONTINUED)	3	(CONTINUED)					POSSIBLY TURKEYS, AND NUMEROUS OTHER SMALL ANIMALS. (ONE OF THE FEW AREAS REMAINING IN THE POWDER RIVER BASIN WHERE COYOTES ARE OBSERVED GOING ABOUT THEIR REGULAR BUSINESS, EXHIBITING LITTLE CONCERN ABOUT THE PRESENCE OF HUMANS.) THIS AREA HAS VALUE FOR COMPARABILITY TO ASSESS ECOLOGICAL CHANGES WITHIN THE POWDER RIVER BASIN AND AS A REFERENCE FOR VALUABLE RECLAMATION OF OTHER LANDS THAT WILL BE AFFECTED BY ANTICIPATED FUTURE MINERAL EXTRACTION OF ALL TYPES. (153)
	4	MIDDLE FORK POWDERED RIVER	WY	JOHNSON	10,950	10,950	THESE LANDS ARE SITUATED IN THE VICINITY OF THE DEEP CANYON CREATED BY THE MIDDLE FORK OF THE POWDER RIVER WHICH FLOWS EASTWARD FROM ITS SOURCE NEAR THE BIGHORN MOUNTAINS DIVIDE. THE CANYON VARIES FROM 500 TO 1,000 FEET IN DEPTH AND PROVIDES SOME OF THE MOST SPECTACULAR SCENERY IN WYOMING. THE PRINCIPAL WILDLIFE INHABITANTS ARE ELK, MULE DEER, MOUNTAIN LION, BLUE GROUSE, HUNGARIAN AND CHUKAR PARTRIDGE, SAGE GROUSE, AND COTTONTAIL RABBITS. THE MIDDLE FORK OF THE POWDER RIVER SUPPORTS RAINBOW, BROWN, AND BROOK TROUT WITH A DENSITY OF 85 POUNDS OF FISH PER SURFACE ACRE. ARCHEOLOGICAL "DIGGINGS" HAVE BEEN FOUND IN THE VICINITY AND THE AREA IS VERY VALUABLE AND PRODUCTIVE FOR HUNTING OF ARROWHEADS AND OTHER ARTIFACTS. THE AREA IF OF CONSIDERABLE HISTORIC VALUE SINCE IT IS LOCATED IN THE HEART OF THE FAMOUS "HOLE-IN-THE-WALL" COUNTRY AND THE "OUTLAW CAVE" USED BY BUTCH CASSIDY AND THE WILD BUNCH AS A HIDEOUT. WITHIN THE NEXT 2 YEARS BIGHORN SHEEP WILL BE TRANSPLANTED TO THIS AREA BY THE WYOMING GAME AND FISH COMMISSION (DUE TO THE ANIMALS NEEDS FOR SECLUSION AND PROTECTION FROM CIVILIZATION AND OTHER INCOMPATIBLE USES). (151)

Table 5 (Cont'd)

BUREAU OF LAND MANAGEMENT (CONTINUED)	5	NORTH FORK CANYON BACK COUNTRY RECREATION AREA (SUITABLE FOR P.A. CLASSIFICATION)	WY	JOHNSON	20,600	2,200	6,920	29,720	THE AREA HAS EXCEPTIONAL SCENIC VALUES ARISING FROM THE SEVERE TOPOGRAPHIC RELIEF; A WIDE VARIETY OF VEGETATIVE ASPECTS, MASSIVE LIMESTONE AND DOLOMITE CLIFFS AND NATURAL ARCHES, AND FLOWING WATER AND WATERFALLS IN THE BOTTOM OF THE CANYON. THE VEGETATIVE VARIETY ASSOCIATED WITH CHANGES IN ELEVATION GIVES RISE TO A DIVERSE SYSTEM OF NATURAL ECOSYSTEMS WHICH SUPPORT AN EXTENSIVE VARIETY OF WILDLIFE SPECIES, BOTH RESIDENT AND MIGRATORY; I.E., ELK, BEAR, COUGAR, BOBCAT, MULE AND WHITETAIL DEER, ANTELOPE AND BIGHORN SHEEP. SMALLER MAMMALS INCLUDE ROCK CHUCKS, PORCUPINES, BADGERS, FOXES, BEAVERS, RED SQUIRRELS, AND CHIPMUNKS. SAGE AND BLUE GROUSE, AS WELL AS COTTONTAIL, SNOWSHOE, AND JACK RABBITS, COMPRISE RESIDEN UPLAND GAME SPECIES. BIRDLIFE VARIES FROM MANY SPECIES OF SMALL BIRDS TO RAPTORS (GOLDEN EAGLE, YEAR-ROUND; BALD EAGLE, WINTER ONLY). FISH POPULATIONS (RAINBOW, BROWN, AND BROOK TROUT, ETC.) ARE IN THE 2,000-2,500 FISH PER MILE RANGE; THIS ALONE LENDS A UNIQUENESS TO THE AREA. LEGAL ACCESS TO THIS BLOCK OF LAND IS ALMOST ENTIRELY CUT OFF BY SURROUNDING PRIVATE LAND AND THE AREA IS ESSENTIALLY ROADLESS. (181)
	6	SEVEN BLACKFOOT AREA	MT	GARFIELD	17,840	1,200	2,480	21,520	THIS AREA IS COMPOSED OF STEEP SLOPES, DEEP WINDING CANYONS, AND PINE-COVERED RIDGES WHICH EXTEND TOWARD FORT PECK RESERVOIR. ASIDE FROM A FEW RESERVOIRS AND A COUPLE OF STOCK FENCES AROUND THE FRINGE, THE AREA IS VIRTUALLY UNTOUCHED. MULE DEER, SHARPTAI GROUSE, MERRIAM'S TURKEYS, COYOTES, AND OTHER ASSORTED SPECIES OF SMALL GAME FREQUENT THE AREA IN LARGE NUMBERS. LEGAL ACCESS INTO THE AREA IS AVAILABLE, BUT ONLY BY HORSEBACK OR HIKING; ALL WELL-TRAVELED ROADS INTO THE AREA CROSS DEEDED LANDS. (134)
	7	TERRY BADLANDS	*	PRAIRIE	27,640	1,880	2,840	32,360	THIS AREA IS COMPOSED OF HIGH, ROUGH SLOPES EXTENDING SOUTH TOWARD THE YELLOWSTONE RIVER. THE UNIQUE GEOLOGIC FORMATION, IN COMBINATION WITH THE COLORFUL VARIETIES OF SOIL MATERIALS, PROVIDES A SCENIC BACKDRO FOR THE PONDEROSA PINE-JUNIPER COVERED HILLS IT PROVIDES EXCELLENT HABITAT FOR MULE DEER, COYOTES, AND OTHER ASSORTED SMALL GAME ANIMALS. ASIDE FROM WATERING DEVICES FOR

Table 5 (Cont'd)

BUREAU OF LAND MANAGEMENT (CONTINUED)	7 (CONTINUED)							LIVESTOCK AND WILDLIFE AND A DIVISIONAL FENCE BETWEEN PASTURES, THE AREA IS VIRTUALLY UNTOUCHED BY MAN, INDIANS HAVE USED THE AREA IN THE PAST (SEVERAL TEEPEE RINGS ARE LOCATED ALONG A RIDGE IN THE NORTHERN PORTION). (143)
	8	TWIN COULEE	MT	GOLDEN VALLEY	6,149		6,149	LOCATED IN A CURRENTLY SPARSELY POPULATED PORTION ON MONTANA, THIS AREA HAS NOT BEEN HISTORICALLY, GEOLOGICALLY, ARCHAEOLOGICALLY, NOR ECOLOGICALLY INVENTORIED. IT IS BORDERED ON THE WEST AND NORTH BY UNDEVELOPED, INACCESSIBLE NATIONAL FOREST LAND (A KNOWN INDIAN CAMPGROUND WITH TEEPEE RINGS, ETC., IS LOCATED ABOUT 2 MILES FROM THE AREA). ACCESS IS LIMITED TO A GRAVEL COUNTY ROAD EAST OF THE AREA. (122)
	9	HELL CREEK - EAST FORK	MT	GARFIELD	10,160	160	10,320	THE AREA IS COMPOSED OF HIGH, ROUGH SLOPES COVERED WITH GRASSES WITH BIG AND SILVER SAGE ALONG THE BOTTOMS OF DRAWS. THESE "BADLANDS" ARE EXTREMELY EROSIVE AND SOILS CONSIST OF CLAY-LOAM AND SILTY CLAY-LOAM VARIETIES. EXCEPT FOR WATER DEVELOPMENTS AND FEW CROSS FENCES, THE AREA IS VIRTUALLY UNTOUCHED BY MAN AND PROVIDES EXCELLENT HABITAT FOR MULE DEER, COYOTES, AND OTHER ASSORTED SMALL GAME ANIMALS. ACCESS IS OVER DIRT ROADS BY 4-WHEEL DRIVE DURING DRY PERIODS. CATTLE AND WILDLIFE USE THESE LANDS INTERMITTENTLY THROUGHOUT THE YEAR. (96)
	10	HELL CREEK - EAST FORK	MT	GARFIELD	9,320	1,880	11,200	THE AREA IS COMPOSED OF GENTLE TO STEEPLY ROLLING HILLS AND SANDSTONE BUTTES COVERED WITH PONDEROSA PINE AND JUNIPER. SEVERAL PARK-LIKE OPENINGS OF GRASS AND BROWSE. THE AREA CONTAINS NUMEROUS DRAINAGES AND ACTIVE GULLIES. THE AREA IS ESSENTIALLY NATURAL EXCEPT FOR FENCES AND RESERVOIRS. ACCESS IS AVAILABLE BY PICKUP, BUT ONLY DURING PERIODS OF GOOD WEATHER. LIVESTOCK AND WILDLIFE USE AREA YEARLONG. AREA IS AESTHETICALLY PLEASING, BUT NOT UNIQUE. (109)

Table 5 (Cont'd)

BUREAU OF INDIAN AFFAIRS	IN GENERAL, TRUST INDIAN LANDS ARE CONSIDERED PRIVATELY OWNED AND ANY USE THEREOF REQUIRES THE APPROVAL OF INDIVIDUAL OWNERS. ACCESS BY NON-INDIANS CAN, THEREFORE, BE SEVERELY LIMITED BY LANDOWNER ACTION. TREATY HUNTING AND FISHING RIGHTS ARE JEALOUSLY GUARDED AND BIG GAME HUNTING BY NON-INDIANS IS PROHIBITED ON ALL MONTANA RESERVATIONS. HOWEVER, FISHING AND UPLAND BIRD HUNTING BY NON-INDIANS ARE PERMITTED ON MOST RESERVATIONS THROUGH A TRIBAL PERMIT.						
(NORTHERN CHEYENNE INDIAN RESERVATION)	1	AREA 1	MT	BIGHORN	44,200	44,200	NOTE I: THE ENTIRE AREA IS BLOCKED INTO RANGE UNITS AND GRAZED BY INDIAN-OWNED LIVESTOCK. ACCESS INTO AND ACROSS IS RELATIVELY EASY AND ALL IS CUT BY LOW STANDARD ROADS, TRAILS, AND BOUNDARY AND PARTITION FENCING. A FAIR POPULATION OF DEER AND UPLAND BIRDS IS MAINTAINED. SOME PORTIONS OF THE AREA CONTAIN ROUGH TIMBERED TERRAIN AND COLORFUL GEOLOGICAL FORMATIONS THAT MIGHT BE CONSIDERED ESPECIALLY SCENIC. (90)
	2	AREA 2	"	"	26,200	26,200	SEE NOTE I ABOVE. (58)
	3	AREA 3	"	"	8,900	8,900	SEE NOTE I ABOVE. (76)
	4	AREA 4	"	"	20,400	20,400	SEE NOTE I ABOVE. (76)
	5	AREA 5	"	ROSEBUD	41,000	41,000	SEE NOTE I ABOVE. (82)
	6	AREA 6	"	"	33,900	33,900	SEE NOTE I ABOVE. (89)
(CROW INDIAN RESERVATION)	7	AREA 7	MT	YELLOWSTONE	19,800	19,800	NOTE II: THESE AREAS ARE ESSENTIALLY OPEN GRAZING, RATHER MONOTONOUS IN CHARACTER, SUPPORTING SMALL POPULATIONS OF DEER, ANTELOPE, AND UPLAND BIRDS. AREAS EXTENSIVELY CUT BY LOW STANDARD ROADS, TRAILS, FENCING, STOCKWATER DEVELOPMENTS, AND OCCASIONAL FARMSTEADS. ACCESS IS RELATIVELY EASY. (80)
	8	AREA 8	"	BIGHORN	111,000	111,000	SEE NOTE II ABOVE. (97)
	9	AREA 9 (PRYOR MTNS.)	"	"	86,400	86,400	LARGELY IN RANGE UNITS AND GRAZED BY BY LIVESTOCK, SOME DEER AND ELK. THE AREA HAS STEEP FORESTED CANYONS, INTERESTING GEOLOGICAL FORMATIONS AND IS ARCHAEOLOGICALLY RICH. GREAT RELIGIOUS SIGNIFICANCE IS ATTACHED TO THE AREA, AND THERE MAY BE RELUCTANCE TO PERMIT ACCESS BY THE PUBLIC. (150)
	10	AREA 10	"	"	97,200	97,200	SEE NOTE II ON THIS PAGE. (86)

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Table 5 (Cont'd)

BUREAU OF INDIAN AFFAIRS (CONTINUED)	11	AREA 11 (BIGHORN MENS.)	"	"	240,000	240,000	LARGELY BLOCKED INTO RANGE UNITS AND GRAZED BY LIVESTOCK, DEER, AND ELK; ONE 14,000-ACRE UNIT IS RESERVED FOR TRIBALLY OWNED BISON (350 HEAD CAPACITY THIS AREA IS CUT BY SPECTACULAR FORESTED CANYONS AND GRASSY DIVIDES FORMING THE EAST BOUNDARY OF THE BIGHORN NATIONAL RECREATION AREA. ACCESS IS LIMITED AND RELATIVELY DIFFICULT. THERE MAY BE RELUCTANCE TO PERMIT ACCESS BY THE PUBLIC AS GREAT RELIGIOUS SIGNIFICANCE IS ATTACHED TO THE AREA. (194)
	12	AREA 12	"	"	27,500	27,500	SEE NOTE II ON PAGE 37 (86)
	13	AREA 13	"	"	89,000	89,000	SEE NOTE II ON PAGE 37 (89)
	14	AREA 14	"	"	199,000	199,000	SEE NOTE II ON PAGE 37 (71)
	15	AREA 15	"	"	139,500	139,500	SEE NOTE II ON PAGE 37 (115)
(FORT PECK INDIAN RESERVATION)	16	AREA 16	"	VALLEY	66,500	66,500	NOTE III: BOTH AREAS SHOWN ARE RANGE UNITS GRAZED BY LIVESTOCK AND DO NOT DIFFER SIGNIFICANTLY IN CHARACTER FROM THE REST OF THE AREA, BUT DO CONTAIN A MINIMUM OF MAN-MADE INTRUSIONS. (64)
	17	AREA 17	"	"	85,200	85,200	SEE NOTE III ABOVE. (64)

APPENDIX I

Wilderness and Roadless Area Inventory Procedures

I. INTRODUCTION

The Northern Great Plains Resources Program is designed to provide information to the states and other administering agencies as guidance in planning the development of coal and other resources in the Fort Union and Powder River areas. The program is a coordinated effort by the federal Government, the states of Montana, North Dakota, Nebraska, South Dakota, and Wyoming, and special interest groups, to cope with the socioeconomic and environmental impacts that may result from the development of energy resources.

The overall program will gather information about the region's resources, including people; and identify various constraints on regional economic, social, and environmental aspects. The result of these studies will be integrated into various resource development alternatives by the Program Management Team in an effort to predict the consequence; and impacts of the various levels of development. This will include impacts on areas outside the region presently designated as Wilderness, Primitive, or by special administrative designation.

The study area encompassed by the surface resources study includes portions of the states of North Dakota (28 counties), South Dakota (7 counties), Montana (20 counties), and Wyoming (8 counties).

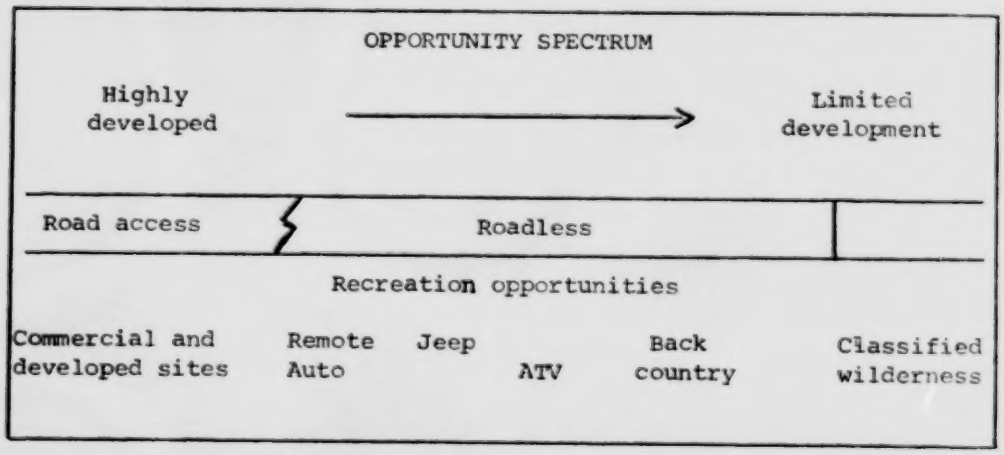
II. OBJECTIVE

Describe the existing and potential wilderness resource within the Fort Union-Powder River region.

III. BACKGROUND

Some of the finest extensive near-natural areas in the nation occur in this region. Many have been identified as roadless (back country), and management direction has been written for the purpose of maintaining these in a natural condition.

This inventory is concerned with that portion of the opportunity spectrum that deals with undeveloped lands where most of the options for management still exist. These areas include all areas which are roadless or essentially roadless.



IV. PROCEDURE

A. Identify and delineate on a 1/2-inch-to-a-mile map

1. All areas contained within lands administered by your agency that are roadless, meet the following criteria, and would--whether or not eligible under the Wilderness Act--qualify for inclusion in the National Wilderness Preservation System.

a. Size - should contain at least 5,000 acres with a minimum dimension of not less than 2 miles between points of road access. Smaller areas of special significance may be recognized.

b. Condition - must be truly unroaded; exclude any areas where parallel wheel tracks would remain plainly visible over two growing seasons.

- Have no major structures or installations such as railroads, transmission lines, concrete dams, tramways, microwave, pipelines, or storage facilities.
- Area not intensively managed for commodity type products.
- The works of man would be unnoticeable.

c. Types of areas - include all areas that meet the above criteria, regardless of present classification, management direction, or administrative designation.

2. All areas contained within lands administered by your agency that are essentially roadless and meet the following criteria:

   a. Should contain about 5,000 acres. Consider smaller or larger areas depending on topography and its relation to providing opportunities for solitude and naturalness or if the area is uniquely wild in nature.

   b. Condition - include areas where four-wheeled motorized vehicle access is common over nonconstructed or extremely low standard roads.

      - May contain structures such as dams, microwave stations, and limited storage facilities.
      - Management activities such as watershed restoration work or intensive range management systems may be in effect.
      - These areas represent opportunities for a back country type experience with opportunities for management conducted to maintain the scenic, wildlife, water quality, vegetative cover, and near-primitive recreation values of the area.

3. Those areas which meet either of the above criteria but their condition will change within the next 5 years as a result of planned management activities exclusive of mineral development.

B. Description

Prepare a short written description of each area and reference it to the map. As a minimum, this should consist of:

1. Approximate acreage by federal, state, and private ownership.
2. General description of the area based on the resource information currently available. Include such items as public access, development plans, permanent improvements, present use, anticipated use, current management direction, ownership, and/or control of the surface resource.
3. Identify special features contained within the areas. These include historical, geological, archeological, ecological, or other unique features.
4. Any other information you believe significant.

C. Quality

Rate the quality index of each area. This is a subjective rating which, when developed, is intended to assist in the evaluation of a particular roadless area. Instructions for rating are on the attached quality index form.

APPENDIX I

Wilderness and Roadless Area Inventory

Quality Index

Area name _____

Area location _____

County _____ State _____

Rated by _____

Organization _____

Address _____

Phone number of rater _____

Basic instructions: The criteria are intended to orient the examiner's thinking and organize his reporting so that basically subjective opinions can be reflected as objectively as possible. Most criteria pertain to the environment, to objects, or to tangible phenomena that can be viewed external and apart from self-consciousness or bias. It is recognized that certain recreation values are themselves subjective or intangible and can only be subjectively evaluated. For example, the feeling of solitude is a recreation value steming from man's interaction with a certain kind of environment. The value is a human one although inherent in the environment. The examiner is expected to rely on his experience and judgment in rating such abstract values.

It is recognized that the areas to be evaluated are uniform only in regard to one characteristic--extent of development. The areas will not necessarily be uniform from the points of view of scenery, isolation, size, and camping quality or variety. In fact, it is most likely that differences in these three recreation characteristics will exist on most--if not all-of the areas to be evaluated. This mixed recreation nature of the area will make application of the evaluating criteria on the whole area basis difficult, although not impossible.

One or more intermediate ratings are indicated for each criterion; other intermediate ratings can and should be assigned where appropriate, but ratings higher than the maximum indicated on the form will not be used. Write the assigned rating for each criterion at the right side of the worksheet near the printed ratings. Sum the totals for each of the three major aspects.

Compute an overall wilderness quality index by distributing 10 weight points among the three major aspects and multiplying as indicated on the quality index computation form.

This rating is to be conducted in the office by individuals familiar with each area. Utilize available inventories to help determine approximate ratings for each category.

APPENDIX I

Scenic quality(s)

Aspect: Landscape & scenery

Rate the following criteria

Number	Criteria	Rating
1	Visual or perceptual aspects include the following components--physiography and earth contours; geological, rock and soil formations; trees and other vegetation; water; sky, skyline and clouds in various combinations and variously affected by the elements.	
	A. The components and combinations are striking.	5
	B. The components and combinations demand notice.	3
2	The visual or perceptual aspects listed above occur in such arrangement and combination that a pleasurable feeling is induced in the observer. This feeling of pleasure or esthetic appreciation is:	
	A. Strong, unique, exhilarating, and remains vivid in memory.	5
	B. Moderate but still unusual.	3
	C. Apparent but not unusual.	1
3	A. Visual or perceptual aspects are free from esthetically undesirable or discordant sights and influences.	4
	B. Esthetic attributes are somewhat depreciated by inharmonious intrusions.	2
	C. Intrusions are serious.	0
4	A. Area is unique within region.	6
	B. Area is unusual, but similar to others.	3
	C. Area interesting, but common within region	1
	Total 8	

Instructions & Interpretations - Landscape & Scenery

The key word in the recognition of scenic aspects is beauty. The experience of beauty is one of varying intensity and value. Scenic beauty is somewhat nebulous and quite often changing phenomenon. The criteria are intended to help rate the basic components that, in combination or re-combinations, tend to produce in the viewer an esthetic feeling and appreciation. The components are physiography and earth contours; geological rock and soil formations; trees and other vegetation; wildlife; water, sky; skyline and clouds; effects of the elements and seasons on one or more of these.

Any object, scene, or area with such components, the perception or appreciation of which is pleasurable, is considered to have natural beauty or esthetic value. The components may vary with the season and time of day. A canyon slope that would go unnoticed in spring or winter would draw admiration and attention when patterned with the gold and bright reds of autumn and the dark green of conifers. A desert mountain in the shadows of evening is a scene of beauty that did not exist in the blazing flat light of midday.

Rate the landscape and scenery that comprise this aspect. Criteria must be applied to rather broad expanses of country in terms of the general panoramic effect.

APPENDIX I

Aspect: Isolation and size

Number	Criteria	Rating
1	A. A feeling of spaciousness with seemingly unlimited horizons.	4
	B. Spaciousness predominates although it is apparent to the user that constraints on free movement are not far away.	1
2	Size of area > +25,000	4
	Size of area 5 - 25,000	2
	Size of area < 5,000	1
3	A. The environment is natural and reflects little or no influence of man and his activities.	5
	B. The environment is essentially natural. However, some features of the environment have been slightly modified by man to provide primitive (non-motorized) access routes and simple convenience-facilities such as campgrounds.	3
	C. Significant modifications of environment, such as fences or buildings (may be on private inholdings), seriously detract from wilderness solitude.	0
4	A. Opportunities for solitude are great.	4
	B. Opportunities for solitude are average.	2
	C. Opportunities for solitude are fun.	1
5	A. Access points are located so as to complement visitor management.	3
	B. Access points are located so as to complicate visitor management.	0
	Total	I

APPENDIX I

Aspect: Variety (V)			
Number		Criteria	Rating
1	A.	Physical opportunities are available for unusual adventure, excitement, challenges, self-reliance.	4
	B.	There are some opportunity for adventure, excitement, challenge, and self-reliance.	2
	C.	Little opportunity for adventure, excitement, challenge, and self-reliance--monotonous.	0
2	A.	Water is present.	6
	B.	Water is absent	1
3	A.	Relative changes in climate, elevation, or ecological conditions provide contrast when viewed in the light of the remaining region.	3
	B.	Similar to remainder of region.	0
4	A.	There are many and varied opportunities for the enjoyment of a wide range of recreational pursuits related to outdoor education, scientific hobbies, natural history studies and observations, plant and wildlife photography.	4
	B.	Opportunities and incentives for informal outdoor education, and for both formal and informal scientific study are unusual but of limited variety.	2
	C.	Opportunities and incentives for informal outdoor limited education, and for both formal and informal scientific study are good but not unusual.	1
5	A.	Presence of unusual composition of plant or wildlife species.	3
	B.	Composition of plant or wildlife species excellent for the region.	2
	C.	Composition normal for the region	1
	Total		V

APPENDIX I

Quality Index Computation

Major aspect	Rating 1/	Weight	Rating x weight
Scenic quality (s)	(24)	(27) 4	
Isolation, size, & camping quality (I)	(25)	(28) 3	
Variety (V)	(26)	(29) 3	
Total		10	2/ (30)

1/ Maximum possible for each aspect is 20.

2/ Maximum possible quality index is 200.

Please complete all rows and columns.

Discussion draft
February 1974

SCENERY

I. INTRODUCTION

The regional profile of existing scenic values within the 140,000 plus square miles comprising the Surface Resources Work Group's study area in Montana, North Dakota, South Dakota, and Wyoming was prepared by the interagency Scenery Subgroup as background data for the analyses of coal development in the Fort Union and Powder River formations as sources of energy.

The evaluation of scenic values is necessarily highly subjective, and the question of what is good or bad scenery depends upon what visual elements contribute to the pleasure of the observer and what elements detract.

The basic visual resources of the earth's surface are such landforms as mountains, plains, river breaks, etc., which result from natural forces; and land patterns, the result of man's manipulation of the surface by minings, farming, reservoirs, etc. (Land Use Consultants, 1971.)

Observations of these two categories form the basis of this report along with such aspects as vegetative cover, water, and, to a lesser degree, the transitory presence of wildlife to add color and variety to the scene which could be a single bull bison in the badlands or the flocks of waterfowl in the pothole country.

II. PROCEDURES

Since no knowledge existed of prior studies that had been made of the study area's scenic values, considerable research was required to determine a method of appraising these values within the time limitation.

The study area landforms as delineated on the 1965 Physical Subdivisions map by Edwin H. Hammond in the National Atlas of the United States (U.S.D.I., 1970) formed the basis of the profile. The study area contains portions of seven of these major subdivisions, with the largest subdivision (No. 3) divided into six distinct landforms for more complete coverage. All divisions are indicated on the accompanying map at 1:1,000,000 scale, and are numbered thusly:

1. Dakota-Minnesota Drift and Lakebed flats.
2. North-Central Lake-Swamp-Moraine Plains.
3. Upper Missouri Basin Broken Lands.
    a. River breaks (cottonwoods, grasses).
    b. Open country, flat (many draws, broadleaf trees, grasses, mixed agriculture and grazing).
    c. Badlands (river breaks - Little Missouri and Powder Rivers).
    d. Open country, rolling (sagebrush, grasses, mixed plant species).
    e. Missouri Slope (short grasses, grazing).
    f. Scattered ponderosa pine country (mountains, open valleys, varied uplands, scenic).

4. Black Hills (including Devils Tower country).

5. Middle Rocky Mountains (Big Horm Mountains).

6. Lower Rocky Mountains (Laramie Range).

7. Wyoming - Big Horm Basin.

To conserve time, responsibility for inventorying the foregoing physical divisions was assigned to individuals and agencies familiar with the subdivisions. Inventory forms were completed for each assigned subdivision or category. These indicated the character of the topography, vegetative variety, unique landform features, land use patterns, and a brief description of the scenic qualities.

The completed inventories were evaluated by a subgroup review committee, and recommendations made as to the more scenic areas within each subdivision or category by states.

III. RESULTS

The following results are based upon the inventory findings complemented by other reference material. Numbers refer to physical subdivisions listed on pages 2 and 3, and shown in Appendix E, Plate 6.

Montana

North-Central Lake-Swamp-Moraine Plains, Sheridan and Roosevelt Counties.

A continuation of the broad, undulating to rolling plains, potholes, and drainages found principally in northern sections of North Dakota. Scenic values are associated with the open spaces of the rolling grasslands and the potholes and lakes such as Medicine Lake, with their seasonal swarms of waterfowl.

Upper Missouri Basin Broken Lands.

River Breaks. Drainages and adjacent territory of the Missouri, Little Missouri, Milk and Musselshell Rivers within the study area, the Yellowstone River upstream to the confluence with the Big Horn River, and the Powder River and Little Powder River upstream to the Wyoming border. While not indicated on the map, the Tongue River is also included in this category.

The Missouri River Breaks adjoining and in the vicinity of Fort Peck Reservoir offer a wild spectacular scenery, composed of high vertical cliffs along the shore of the reservoir which recede in height as they progress outward

from the body of water. Narrow, deep canyons bisect the land in every direction. North slopes have ponderosa pine and juniper cover. Natural erosion is active. Wildlife species include elk, mule deer, wild turkey, sharptail grouse, bobcats, coyotes and mountain lions.

The Missouri River Breaks between Fort Peck Dam and the North Dakota border are less pronounced: they have moderately steep slopes with generally a broad flood plain. Junipers grow on the slopes with pockets of Ponderosa Pine. Grasses occur on the slopes as well as the flood plain and the plains above the breaks. The fall colors of the river side cottonwoods and other hardwoods make that season the most scenic of the year. Some agricultural cultivation takes place on the flood plain and it is traversed by highways. Mule deer and other game animals frequent this area.

The lands along the Yellowstone River are extremely rough and rolling badlands, particularly between Miles City and Glendive. They consist of high silty buttes and saddles with scrub juniper and grass cover and are extremely subject to erosion. Specific landform features which enhance the scenic values are Signal Butte and Terry Badlands. Signal Butte's natural esthetic qualities have been impaired by installation of transmission and microwave towers. The colorful geologic composition of the Terry Badlands provide

a scenic background for the pine and juniper-covered foreground hills. There are no noticeable land patterns in these badlands. Mule deer and coyotes provide wildlife interest.

The Powder River drainage is characterized by large, rough, sloping buttes enclosing the river with erosion very evident throughout its length. Vegetative cover consists of clumps of ponderosa pine and juniper on north slopes. Scenic values are those associated with "badlands." Wildlife interests center on large populations of mule deer, sharp-tailed grouse and "varmints."

The scenic values associated with the Tongue River bottoms, again, are the highest during the autumn with the coloring of the ash, cottonwoods, willows, and deciduous shrubs.

Land patterns throughout the River Breaks category are quite evident where roads exist, and telephone and power transmission lines are abundant, with overhead lines running in all directions.

The additional scenic attraction of islands occur in the Yellowstone River and the stretch of the Missouri below Fort Peck Dam. These islands are virtually free of land patterns, and abound with wildlife. Several of the islands are considered as being "relict areas" of vegetative cover.

Flat Open Country. This category is characterized by gentle slopes with well defined generally shallow drainage patterns. Some rough, broken slopes occur at the edge of terraces and along deep drainages. It comprises the majority of the lands in the north and eastern portions of the Montana study area. Vegetative cover consists of mixed prarie grasses and sagebrush, plus other varieties of browse --primarily along the drainages. The principal tree is the cottonwood, also found along drainages.

Apparent land patterns throughout this category are transmission lines, roads, oil fields, towns, pipelines, etc. However, because of the low population density, the area retains much of its "open space" qualities. Large agricultural acreages are present in Carter, Dawson, Fallon, Garfield, McCone, Prarie, Richland, and Wibaux Countie..

Scenic values do not include the variety of other categories. This country offers a spaciousness and serves as a buffer zone and foreground for other more varied areas. Unique landform features include the following areas:

Smoky Buttes, Garfield County. The scenic interest of this ridge lies in the variety it adds to the surrounding flat plains.

Hole-in-the-Rock and Little Hole-in-the Rock, Garfield and Rosebud Counties. Natural wind and water erosion form small openings in sandstone formations. Scenic interest

relies upon variety introduced by vertical objects in the relatively flat countryside.

Big Sheep Mountain, Prairie County, is a moderately sloping low mountain with draws around the base. Its slopes are covered with hardwood shrubs and ash trees with cottonwoods in the draws. Mixed-prairie grasses are found on the ridges. Such land patterns as roads, pipelines, and overhead telephone lines are few in number and presently not too noticeable. The area is frequented by whitetail and mule deer, coyotes, bobcats, sharptail grouse, etc. The scenic value lies in the topographic variety the mountain provides in this flat grazing country, it being the highest point in this area.

Little Sheep Mountain, Prairie County, is about 10 miles south of Big Sheep Mountain and, except for being lower in elevation, its scenic qualities are the same.

Piney Buttes, Rosebud County. These rough rolling juniper covered hills add scenic variety to the landscape. One of the pleasing aspects is the absence of land patterns.

Chalk Buttes, Carter County, are located at the southern end of the flat open country category. The scenic qualities of the buttes hinge on their white limestone color in contrast to the surrounding flat grasslands and rolling grass and Ponderosa Pine covered hills. Land patterns of the area are based upon grazing and production

of livestock forage. The presence of several transmission lines and use of the buttes for microwave facilities detract somewhat from scenic quality.

Rolling Open Country, Carter and Powder River Counties. This southeast Montana area consists primarily of rolling grasslands. The western portion in the Powder River drainage is more rolling and broken than the eastern portion, (Little Missouri River). Principal landform features are scattered buttes with the more outstanding being Capitol Rock, Chimney Butte and Sheep Mountain in the northern section. The buttes frequently have conifers around their base and on their slopes. Land patterns are those associated with grazing and thus are not very evident.

Finger Buttes in Carter County, are spire formations of white limestone which rise abruptly from the surrounding plains. A unique feature of these buttes is the "Bell Tower Rock" located in a saddle between spires which is described as resembling the Liberty Bell. Vegetative cover is predominantly grasses with some scattered Ponderosa Pine. Adjacent land patterns are those associated with grazing which have little impact upon the buttes. The buttes contain several caves; some of which have not been explored. Wildlife common in this area include mule deer, pronghorn antelope, sage and sharptail grouse, coyote, bobcat, etc. The scenic value of these buttes is one of variety of form and color.

Missouri Slope, Dawson, Wibaux, and Carter Counties. The landscape is chiefly characterized by long and wide slopes with some undulating to hilly areas. The vegetative cover is predominately mixed-prarie grasses and land use is grazing and dryland farming. Scenic qualities are associated with the "wide open spaces" landscape and certain areas offering variety such as the following:

Makoshika State Park locality, Dawson County, has a rough colorful badlands topography resulting from wind and water erosion. Vegetative cover is Ponderosa Pine and juniper with a grass-browse understory. The exposed soil strata on the steep hillsides and ridges, together with the conifer growth on the ridgetops, create the scenic qualities of the area. Active erosion in the deep canyons and saddles provides a continuing change of form and color. Mule deer and a variety of small game provide the wildlife interest. Several transmission towers and microwave stations are located within the area and detract from the esthetic qualities in the immediate vicinity.

Blue Mountain, Wibaux County, is a long flat plateau approximately 1,000 feet higher than the surrounding country which is relatively flat. The vegetative cover is deciduous trees, shrubs and grass. Wildlife interest is provided by mule and whitetail deer, sharptail grouse, and a variety of small game. Adjacent land patterns are

dry-farmed areas and grazing with few manmade disturbances within the area. The scenic qualities of the site result from the variety in elevation and contrasting vegetation to the surrounding grasslands.

Scattered ponderosa pine country, Big Horn, Custer, Musselshell, Powder River, Rosebud, Treasure and Yellowstone Counties. This category offers a wide variety of landscapes including both flat and rolling plains, benchlands, badlands, hills, mountains, streams and broad valleys. The ponderosa pine are dominant from the Powder River west to the foothills of the Big Horn Mountains and south of Billings. North of Billings and Hardin, pine and juniper occur in scattered pockets in the rolling plains and along ridges. Wildlife found in the area include mule and whitetail deer, wild turkey, pheasant, sharptail and sage grouse, bighorn sheep, coyote, bobcat, etc.

Land patterns created by man include both dry and irrigated farming, grazing, surface mining, reservoirs and irrigation systems, road systems, transmission lines, oil refineries, towns, and one moderately sized city, Billings. Impact of these developments is principally of a local nature.

The scenic values of this category are due to the interesting variety of landforms. Scenic features include the open parks surrounded by pine covered hills, the broad valley of the Yellowstone River with its colorful rimrock sandstone buttes and ledges that provide a pleasing foreground for views of near and distant mountain ranges, and the interesting land patterns of the vast wheat strip farming, readily apparent to air travelers.

The following specific features add to the scenic qualities of this category.

Bull Mountains, Musselshell County, are low and isolated, characterized by caves, sharp ridges and box canyons. Vegetative cover consists of ponderosa pine, shrubs and grasses. Their scenic attraction lies in the rough wild nature of the area and the contrast to the surrounding rolling plains.

Rimrocks, Yellowstone County, is a spectacular escarpment resulting from erosion which has exposed alternating thin layers of colorful sandstone and shale. Its present vegetative cover where soil has accumulated are junipers, shrubs, and grasses. In addition to the scenic values of the rimrock when seen from the valley, it also provides spectacular views of five major mountain ranges, the Yellowstone River valley, and the development pattern of Billings, particularly when viewed at night.

Maxwell Butte, Custer County, is probably more significant as a historical site than for its scenic value. However, it does provide landform variety to the surrounding rolling plains. Its vegetative cover consists of junipers and mixed-prairie grasses.

Castle Rock, Rosebud County, is a sandstone formation rising vertically from a flat benchland adding scenic variety which is enhanced by a background of pine covered rolling hills. The vegetative cover is grasses and the land use is grazing. Land patterns consist of a county road near the base and coal strip mines as near as two miles to the east.

Middle Rocky Mountains.

The Big Horn and Pryor Mountains are representative of this physical subdivision in Big Horn County. Because of the scenic interest and proximity to the study area the continuation of the Pryor Mountains in Carbon County is included in this profile.

The Big Horn Mountains in Montana present an ever increasing rise from the benchlands, foothills, and flood plain of the Big Horn River to culminate in the picturesque peaks and ridges in Wyoming. The mountains are deeply incised with canyons including Big Horn Canyon, now the site of Yellowtail Dam and Big Horn Lake, Black Canyon, Big and Little Bull Elk Canyons, and Porcupine Creek which continues into Wyoming.

Vegetative cover includes deciduous trees, shrubs, and grass at the lower levels with conifers replacing the deciduous trees at the higher elevations. Wildlife in this area includes mule deer, elk, black bear, martens, coyotes, bobcat, blue and ruffed grouse, with occasional moose, mountain lion and lynx. Bison have been restocked on the Crow Indian tribal lands.

The Pryor Mountains present a more rugged picturesque appearance with gently sloping upland meadows and a series of rocky ridges. Stream drainages are generally shorter and more shallow than on the Big Horn side of the reservoir. A major drainage is Dry Head Creek. However, the resulting ravines and canyons are as colorful because of the rock strata as those on the Big Horn side. Numerous caves, including ice caves and underground streams, are other features of the Pryors. Vegetative cover is similar to that in the Big Horns. Wildlife is also the same except for the absence of moose and bison and the presence of wild (feral) horses in the National Wild Horse Range.

The principal land pattern in both areas is associated with grazing with more manmade features - structures, fences, and trails on the Pryor side. Both sides share Yellowtail Dam and associated structures. A major power transmission line follows Big Horn Canyon on the Pryor side into Wyoming.

The highly scenic values of this subdivision are derived from the variety of landforms, vegetation, wildlife interest, primitive qualities, colorful exposed geologic formations, and the land pattern created by Big Horn Lake.

Montana Summary.

The following subdivisions and categories are considered to possess high scenic values within the Montana study area. They are not listed in any ranking order.

Missouri Breaks

Big and Little Sheep Mountains

Chalk Buttes

Bull Mountains

Generally the south half of this category.

Big Horn and Pryor Mountains.

North Dakota

Dakota-Minnesota Drift, Bottineau, Burke, McHenry, Pierce, Renville and Ward Counties.

Glacial deposits (drift) from this gently rolling prairie which is broken by low ridges of hills, shallow draws (coulees), numerous lakes and potholes and poorly developed streams. Vegetative cover includes grasses and along streams, deciduous trees and shrubs. The dominant visual wildlife interest is the seasonal presence of waterfowl, this area being one of the Nation's prime nesting grounds. Other wildlife include white-tail deer, Hungarian partridge, pheasant, red fox, squirrels, and in the Turtle Mountains, ruffed grouse and an occasional lynx. Land patterns reflect the high agricultural use with section line roads, some strip coal mining and a network of telephone and electric transmission lines.

The western end of the Turtle Mountains is in the extreme northeast corner of the study area. This is a rolling plateau having densely wooded hills with a relative relief between 100 to 500 feet above the surrounding level prairie. Land patterns include the county road network and some cleared agricultural lands. The scenic qualities are derived from a combination of the wooded hills and lakes and the contrast in elevation and vegetation with the surrounding country.

The principal stream of the subdivision is the Souris River which meanders through its valley, formerly a small glacial lake bed. Land patterns include intensive agricultural use, networks

of roads and transmission lines, railroads, villages and the City of Minot. Scenic interest in this area derives from the meandering river with its clumps of trees, such lakes as Lake Darling and the farm patterns with their cultivated fields and windbreaks.

Sand Dunes in northern and central portions of McHenry County provide a scenic contrast to the surrounding landscape because of their regular series of ridges. The vegetative cover is trees and grass, and the land use is grazing.

North Central Lake-Swamp-Moraine Plains, Burleigh, Divide, McLean, Sheridan, Ward, Emmons, Kidder and Mountrail Counties.

Landforms in this subdivision range from hilly country with numerous knolls and ridges to broad nearly level or undulating or rolling plains. Numerous lakes and many potholes are scattered throughout the area. Vegetation variety ranges from grasslands to trees and grasses along drainages to shrubs and grasses. Land patterns include mixed agricultural use, road systems, major electric transmission lines, radio and microwave towers, towns and villages and coal strip mining. Whitetail deer, upland game birds and the seasonal multitudes of waterfowl are the principal wildlife attractions.

Specific areas with scenic qualities follow.

Keever and Solberg Buttes in Burleigh County provide scenic contrast to the adjoining grasslands and cultivated fields.

Dog Den Butte in McLean County provides the same scenic contrast as the foregoing buttes as well as being the highest point in the vicinity. Vegetative cover is shrubs and grass and the land use is grazing.

Prophet Mountains in Sheridan County offer a scenic variation from the surrounding pasture lands as a moderately sloped glacial moraine.

The Des Lacs River drainage in Ward County provides a very pleasing variation to the undulating plains. Deciduous trees occur on the stream banks and the valleys' slopes are grass covered. Land patterns are those associated with agriculture and grazing.

Upper Missouri River Broken Lands.

River Breaks, the streams and land adjacent to the major streams including the rough broken lands of the stream banks.

In North Dakota this category includes the Missouri River from the South Dakota border to the Montana line including Lake Sakakawea, the Knife River, the Heart River and the Cannanball River - Cedar Creek Breaks.

The Missouri River Breaks throughout North Dakota, while not as spectacular as the Missouri Breaks in the Montana Fort Peck Reservoir area, do present scenic qualities associated with the wooded and generally broad river bottoms, the high steep bluffs, wooded deep coulees opening into the benches or bottomlands, and the rolling hills and buttes back from the

bluffs. The wooded draws or coulees also provide wildlife cover and added scenic interest. The bluffs and buttes become steeper and more pronounced in the Lake Sakakawea area as compared to the stretch between the South Dakota line upstream to Garrison Dam. One of the more scenic portions of the Lake Sakakawea reach is between New Town and Williston. This reach has the spectacular Crow Flies High Butte immediately west of New Town and the area contains many scenic vantage points for viewing the reservoir and the picturesque buttes south of the impoundment. The combination of woods, grass, water, exposed soil and rock bluffs and the distant vistas creates the scenic qualities of this region. Land patterns include irrigated and nonirrigated farms in the bottomlands, grazing on the grassy slopes and uplands, coal strip mining and gravel pits occasionally in the coulees, transmission lines, highways, bridges, towns and one city, Bismarck.

The Knife River Breaks lie within Dunn, Mercer and Oliver Counties. These breaks are not as pronounced as the preceding breaks, the enclosing bluffs being lower and the wooded draws shallower. Vegetative cover includes trees, shrubs, and grasses. In addition to the draws, deciduous trees and shrubs occur along the river, while the uplands are rolling grassy plains. Land patterns include upland grazing, some cultivated farmlands in the bottomlands, road and telephone and power transmission systems, towns and coal strip mining.

The Heart River Breaks extending into the rolling Missouri slope in Morton, Grant, and Stark Counties are similar to the Knife River breaks. Vegetative cover and the land patterns are likewise similar. Additional scenic interest is provided on the Heart River by the two reservoirs, Lake Tschida and Lake Edward Arthur Patterson.

The foregoing characteristics are also appropriate for the Cannonball River and Cedar Creek drainages in Sioux, Adams, Grant and Hettinger Counties. This area does provide significant whitetail deer habitat.

The scenic values of these three river drainages derive from the variety provided to the surrounding rolling plains by the wooded river valleys, the streams and reservoirs, and the sharp breaks in topography.

The Little Missouri River Breaks in Dunn County between the Badlands (3c) and Lake Sakakawea provide a different type of scenic resource by having moderate-to-steep side slopes and draws and heavily wooded cover with intermingled sagebrush and grassy areas.

Flat open country, Golden Valley, McLean, Mountrail and Williams Counties.

The portion of Golden Valley County within this category has several buttes which add scenic variety to the undulating plains. They include Sentinel Butte which rises abruptly over 500 feet from the surrounding grasslands.

Its vegetative cover consists of trees, shrubs and grasses. Land patterns include grazing around the base, radio towers on the top and a scenic drive to the top which provides observers with commanding views of the plains to the west and the scenic Little Missouri Badlands in the other directions.

Rocky Butte to the southwest of Sentinel Butte is slightly lower and smaller in mass with more moderate slopes. Its vegetative cover is grasses and land patterns are associated with grazing.

Camels Hump Butte to the northeast of Sentinel Butte also rises over 500 feet above the surrounding plains. It has steep slopes and a form resembling an extinct volcano cone. Vegetative cover is grasses and land patterns reflect grazing.

The scenic values of this category in McLean, Mountrail and Williams Counties are associated with gently rolling expanses of open country and the numerous small lakes and potholes. Vegetative cover is trees, shrubs and grass while the land patterns reflect mixed agricultural use and oil and gas development.

Badlands. These badlands are on both sides of the Little Missouri River from about the South Dakota line to near the river's confluence with Lake Sakakawea. The valley formed ranges in width from 5 to 30 miles. Moving waters carved the valley into the ancient preglacial plain resulting in a fantastic array of colorful buttes and canyon walls. The colors include layers of whites, reds, yellows and grays which are derived from clays, bentonite and "scoria". The brick red scoria resulted from burning veins of exposed lignite. Butte and mesa formations are more prevalent in the southern portion of the area. Significant buttes in this category include Flat Top Butte which is a golden eagle nesting area, Chimney Butte, named for its resemblance to a chimney, Bullion Butte, Tepee Butte, Two Top

Mesa and Big Top Mesa. The variety of vegetative cover also enhances the scenic qualities of these badlands. Along the streams stands of deciduous trees, with cottonwood the dominant species, and shrubs occur along with excellent grass cover. Green ash and junipers are found on north facing slopes with a columnar form of juniper found in a few areas generally in association with burning lignite veins. Yucca, cacti and greasewood occur with the ever present mixed-prairie grasses and sagebrush on south facing slopes. Both Ponderosa pine and Limber pine are found in isolated groves (Alsberg, 1950). Wildlife, a component of visual resources, is also present in variety. Stream bottomlands and wooded draws provide food and shelter for both whitetail and mule deer. Other animals of interest include raccoons, porcupines, prairie dogs, coyotes, foxes, bobcats, and golden eagles. A few wild (feral) horses are present in isolated areas, and bison, bighorn sheep and pronghorn antelope have been reintroduced in some locations.

Principal land use is grazing, which does not create much of a land pattern in this category aside from fences, trails, and scattered ranch building sites. Road patterns are not too obvious, the badland being crossed by only two major highways and one interstate route. Two towns, Marmarth and Medora, are the only present urban developments.

The combination of the foregoing aspects of the badlands account for their significant present scenic values.

Missouri Slope is considered to be the rolling irregular grasslands in North Dakota exclusive of the River Breaks and the Badlands lying west and south of the Missouri River. The area includes all or portions of Adams, Billings, Dunn, Grant, Sioux, Hettinger, Morton, Stark, McKenzie, and Slope Counties.

Dominant vegetative cover is mixed-prairie grasses with deciduous trees and shrubs in draws and near streams and lakes, and mixed shrubs (sagebrush) and grass.

Wildlife found in this area of scenic interests, includes sage and sharp-tailed grouse, mule, and whitetail deer, pronghorn antelope, coyotes, beaver, and wild turkey.

Specific areas of scenic resources include the following.

Square Butte, Whitstone Buttes, Wolf Buttes, Cow Butte, Pearl Butte, Cedar Butte, Talbot Butte, and Saddle Butte are located in Adams, Bowman, and Billings Counties. These buttes range in height above the plains 100 to 500 feet, and, accordingly, are prominent features of the Missouri Slope country. Saddle Butte varies from the others in having steeper side slopes and being grass covered rather than having the shrub-grass vegetative cover. It is also grazing territory, whereas the other land patterns represent mixed agricultural use.

The Killdeer Mountains in Dunn County are two large hills--their highest points rising 600 feet above the plains. Their steep side slopes are densely wooded, while the tops have open, grassy parks in tree cover. Land patterns are associated with grazing.

Horse Nose Butte, Dunn County, is a moderate to steep sided landform with a sagebrush-mixed-prairie grasses vegetative cover. Associated land pattern is grazing.

Lake Ilo, Dunn County, adds the interest of a body of water to the scenic resources in this somewhat arid landscape. Vegetative cover consists of native mixed-prairie grasses and vegetation normal to lakeshores.

The southeastern Missouri Slope Counties of Grant, Morton and Sioux present a more varied and broken landscape than Oliver and Mercer to the north. The variety includes buttes, "hogbacks" and hills. Some of the more significant landforms are Heart Butte, Pretty Rock Butte, Dog Tooth Buttes and Coffin Butte in Grant County; Eagle Nose Butte, Signal Butte, Square Butte, Huff Hills and Little Heart Butte in Morton County; and in Sioux County, which is also part of the Standing Rock Sioux Indian Reservation, the hills and buttes west of Fort Yates. Vegetative cover is predominantly grass, in Sioux County hardwood draws and intermingled sagebrush are present. Grazing, with some farming in Grant County, are the principal land patterns with coal mining in the northern counties. Hettinger County landscapes are a continuation of the rolling grasslands, broken by buttes and low hills present throughout the adjoining counties. The more significant landforms are White Butte, Teepee Buttes, Black Butte, Stony Butte, and Bull Butte. Grazing creates the dominant land pattern.

The part of McKenzie County north of the Little Missouri River Badlands and breaks possesses considerable scenic resources offering variety to the Missouri Slope plains in the form of wooded draws, scenic buttes, and broken lands. The steep sloped Blue Buttes are some of the more picturesque visual resources in this area. These landforms rise over 500 feet to their crests from the surrounding grasslands. Vegetative cover is shrubs and grass with trees and shrubs in protected areas and in drainages around the base.

Slope County has the distinction of having the highest point in North Dakota within its boundary. This is White Butte with a top elevation of 3,506 feet or a relative relief of over 500 feet. Directly west of this butte is another State high point, Black Butte, with a top elevation of 3,468 feet and also over 500 feet above the surrounding country. Some of White Butte's scenic interest lies in the barren slope sides, the exposed lighter soil giving the butte its name. Grassy uplands are also present on the butte. Black Butte's vegetative cover is mixed shrubs, including sagebrush and mixed-prairie grasses.

Two other buttes are dominant in the open plains landscape. These are West and East Rainy Buttes. Their tops also are over 500 feet above the adjacent land and have a grass vegetative cover.

White Lake, Stewart Lake and Cedar Lake provide the added scenic interest of wetlands in this area of intermittent streams and low rainfall. They are surrounded by grasslands and serve as wildlife refuges.

Besides the usual terrain of rolling grasslands and scattered buttes, one of Stark County's landform features is the Little Badlands southwest of the town of Dickinson. These badlands are broken lands and low buttes with a prevalent white chalky appearance because of their volcanic ash origin. Vegetation is sparse and composed of mixed-prairie grasses with some sagebrush and trees.

Davis Buttes are a large low dominant landform northwest of Dickinson with a shrub-grass vegetative cover. An abandoned radar base on top of the butte infringes upon the scenic values associated with the area.

Young Man's Butte in the eastern part of the country is a major landmark for the immediate area. It has moderate slopes and is within the 100 to 500 feet height range compared to the surrounding area. Vegetative cover is grasses.

The scenic values found in the Missouri Slope category are those associated with rolling grassy plains accompanied by a feeling of spaciousness. Breaks of these extensive grasslands are provided by the vertical lines and sometimes picturesque appearance of the scattered buttes. Land patterns include the dominant grazing use, some agricultural cultivation, coal mining, villages and towns, telephone and power transmission lines, road networks including Interstate No. 94 and radio and microwave towers.

North Dakota Summary

The following subdivisions, categories and/or features are considered to possess high scenic values within the North Dakota study area. These areas are not listed in any ranking order.

Lake and Pothole Country

Des Lacs River Valley

Crow Flies High Butte and area to west

Sentinel Butte locality

Little Missouri River Badlands

Blue Buttes locality

Killdeer Mountains

South Dakota

Upper Missouri Basin Broken Lands.

River Breaks within the study area include the Grand, Moreau, and Cheyenne Rivers in Corson, Dewey, Perkins and Ziebach Counties. These breaks are incised into the gentle slopes of the surrounding plains of the Missouri Slope. The relative relief of the breaks is in the 100 to 500 feet range and the vegetative cover is mixtures of grass and shrubs. The breaks of the Grand River are within the Standing Rock Sioux Indian Reservation while those of the Moreau and Cheyenne are in the Cheyenne River Sioux Indian Reservation. Grazing is responsible for the dominant land pattern. Wildlife present in the area includes antelope, deer and upland game birds.

Scenic values are associated with the variation of the undulating surrounding plains by the indented valleys and the interest the stream adds to this dry country.

The Missouri Slope in Corson, Dewey, Harding, Meade, Perkins, and Ziebach Counties presents scenery associated with the wide open spaciousness of rolling grassy plains, the surface being broken by well defined drainage patterns and picturesque buttes. Grazing creates the principal land pattern with some cultivated croplands, roads and trails, transmission lines and a few small towns. White-tailed and mule deer, pronghorn antelope, upland game birds including pheasant, sage grouse in the western portion of the study area, sharptailed grouse, and wild turkey. Migrating waterfowl which use the numerous stock-watering ponds, coyote, bobcat, prairie dogs, and golden eagle are among the wildlife adding transitory interest to the scenery.

The Missouri Slope in Corson, Dewey and Ziebach Counties has similar general scenic resources with the exception of greater relative relief. Corson County is within the Standing Rock Sioux Indian Reservation while the Cheyenne River Sioux Indian Reservation lies within Dewey and Ziebach Counties. A unique scenic feature of this specific area is Thunder Butte in western Ziebach County.

The topography has less relative relief in Butte, Meade and Perkins Counties than in the prior area. Land patterns reflect cultivated land, irrigation systems and Belle Fourche Reservoirs as well as grazing. Scenic interest is enhanced in this locale by Castle Rock Butte, Haystack Butte, and lower Deer Ears Butte in Butte County and Bear Butte in Meade County.

Harding County offers some of the more scenic country in the South Dakota study area. The Cave Hills, Slim Buttes, and Short Pine Hills provide scenic vertical variety with scattered pines and numerous vista points. It also contains outstanding rock formations such as the "Castles in the Slim Buttes." Land patterns created by recreation use--trails, camps, etc., occur along with the numerous stock-watering reservoirs.

Black Hills.

The northern section of this ancient mountain range is in Lawrence and Meade Counties. Slopes are generally steep and relative relief exceeds 500 feet above the surrounding wavy plains. Their rolling hills and ridges are covered by ponderosa pine, with some deciduous trees and shrubs along the streams at lower elevations. Grasses and shrubs occur in occasional parks and at the base of the foothills. Wildlife affording scenic interests includes mule and whitetail deer, coyote, beaver, wild turkey, bobcat, red fox and golden eagle. Land patterns reflect both surface and subsurface mining for gold, silver, rock, sand and gravel and bentonite; grazing, microwave and radio towers, roads and trails, wood products, recreation developments and the towns of Lead, Spearfish and Sturgis.

The scenic values of this portion of the Black Hills are associated with the rounded forested hills and rushing small streams with occasional views of wildlife in a natural setting. A unique feature of this subdivision is the Wonderland Cave area at the edge of the Black Hills in Meade County while a scenic attraction is Spearfish Canyon on Spearfish Creek in the northern part of the subdivision.

South Dakota Summary

Features considered to possess high scenic values within the South Dakota study area are:

Buttes in Butte and Harding Counties

Rolling grasslands

Black Hills.

Wyoming

Upper Missouri Basin Broken Lands.

River Breaks. This subdivision category in Wyoming is represented by the Little Missouri and Little Powder Rivers in Crook and Campbell Counties and the Powder River Breaks in Campbell and Sheridan Counties. Relative relief of these river breaks and surrounding lands is less than 100 feet with gentle side slopes. Vegetative cover includes combinations of trees, shrubs and grasses. Land patterns reflect the major use of the area which is livestock grazing.

The Little Missouri and Little Powder Rivers are quite scenic within their corridors. Heavy cottonwood growth along the river banks contributes to visual resources providing vertical interest during the winter, glossy green leaves during the spring and summer and the brief striking gold colors in the autumn. Views of the rolling and broken foothills of the Black Hills are visible from the Little Missouri River breaks while the Little Powder River affords scenic views of the ponderosa pine covered ridges defining its drainage. The presence of running water also contributes to the pleasure of the observer. The Little Powder flows during most of the year and the Little Missouri throughout the year.

The Powder River Breaks between the Montana State Line and the badlands are similar to the foregoing but are rougher and more deeply eroded.

Badlands in Wyoming refer to those of the Powder River in Johnson and Sheridan Counties. This rough broken landform begins upstream of the town of Arvada in Sheridan County and continues to the vicinity of the towns of Sussex and Kaycee in Johnson County. The area is characterized by a typical plains stream valley with hawthorns and cottonwoods along the muddy river. The slopes are moderate on the lower walls whereas the breaks in the higher grounds are rough and short steep slopes. Some of the draws support shrubs, but the general vegetative variety is a tree and grass cover. Where suitable, the valley is used for haylands with some cultivated crops near Arvada. The higher ground is used for grazing. The scenic qualities of this area relate to its wild remoteness and the picturesque tree lined river bottom in contrast to the adjoining dry plains.

Rolling Open Country in Wyoming is a continuation of the Great Plains-Missouri Plateau into the Wyoming counties of Campbell, Converse, Crook, Johnson, Natrona, Niobrara, and Weston. Topography is variable, with rolling plains, broad level river valleys, and low hills and buttes. The vegetative cover is grasses and shrubs, the principal shrub being sagebrush. Land patterns include grazing, strip mining, oil and gas developments, crop cultivation including some irrigation, networks of highways including Interstates Nos. 25 and 90 and transmission lines. The City of Casper is in the extreme south portion of the area. Wildlife is most commonly

represented by the pronghorn antelope which adds scenic interest to the grass and sagebrush landscape. Other wildlife includes mule deer, whitetail deer to a lesser extent, coyote, bobcat, red fox, sage and sharptailed grouse, pheasant, Hungarian partridge, wild turkeys and seasonal migratory waterfowl including ducks, geese, sandhill cranes and whistling swans.

Scenic values present in the major part of this category are those associated with the spaciousness of the rolling grasslands broken by views of mountain ranges, buttes and other contrasting landforms.

Specific areas offering scenic resources include the following.

North Platte River corridor along the southern edge of the study area provides scenic interests related to a flowing stream with clumps of cottonwoods and other deciduous material on its banks, the land patterns created by irrigated farmlands and a foreground for views of the wooded Laramie Range.

Pumpkin Buttes in southern Campbell County are four separate formations rising abruptly from the countryside for a height of 800 feet, thereby providing a spectacular contrast to the rolling plains.

The Hat Creek Breaks and Rawhide Buttes in southeastern Niobrara County add to the scenic resources through their wooded landforms which add variety to the surrounding plains.

Scattered Ponderosa Pine Country in Johnson County between the Powder River and the Big Horn Mountains combines gently rolling grasslands with the many streams flowing out of the mountains. These streams are lined with cottonwoods, willows and other deciduous trees and shrubs with conifers extending out from the mountains for a few miles in these drainages. The land patterns created by the estate type ranches nestled against the foot of the scenic Big Horn Mountains create additional visual resources. The landscape becomes more rolling and dry toward the Powder River. Other land patterns include highways and trails, hay meadows, mining and oil and gas development.

Black Hills (including Devils Tower Area).

The Black Hills in Crook and Weston Counties have been extended for this study to include the Bear Lodge Mountains to the northwest and the high valley between the two ranges. The side slopes of the ranges are steep with the valley slopes being moderate and the area west of the Bear Lodges blending with the rolling open grasslands. About 75 per cent of this subdivision's relative relief falls into the 500 feet and over classification, the drainage of the Belle Fourche River and the area south and west of Newcastle having elevation differences in the 100 to 500 feet range. The only areas, with 100 feet or less differences are the lower ends of the Belle Fourche and Redwater River drainages.

The dominant vegetative cover is ponderosa pine and spruce which cover the mountains and ridges. The western part and some of the separating high valley is grasslands consisting of sagebrush and mixed-prairie grasses.

In addition to the Black Hills and Bear Lodge Mountains, another

feature providing scenic value is Devils Tower, a unique formation consisting of a stump-shaped cluster of rock columns 1,000 feet across the base with a 275 feet wide top and rising 865 feet above its wooded base. The nearby (to the northwest) Missouri Buttes rise to an elevation nearly as high as the tower. Inyan Kara Mountain rises over 600 feet above its surroundings with an elongated peak rising sharply from its semi-circular rim and Grand Canyon of Sand Creek is an incised section of this drainage on the northwest slopes of the Black Hills.

Land patterns in this subdivision include oil and gas development, surface mining, highway systems, some agricultural cultivation, Keyhole Reservoir on the Belle Fourche River and transmission lines. Wildlife of scenic interest include small populations of elk and bighorn sheep, numerous mule and whitetail deer, wild turkey, ruffed grouse, and occational mountain lion, coyote and bobcats. Variety in landforms is the major scenic attraction of this area plus the coniferous tree cover and the probability of viewing wildlife in a natural setting.

Middle Rocky Mountains (Big Horns) in Sheridan, Johnson and Natrona Counties.

This landform provides some of the most spectacular and high quality scenery in the Wyoming portion of the study area. Topographic elevations range from approximately 5,200 feet in the eastern and southern foothills to Cloud Peak of 13,175 feet. Enhancing the scenic values of the landforms are the diversity of form, texture and pattern of the vegetative cover which includes expanses of trees and grasslands as well as mixes of trees, grasses and shrubs. This

cover variety in contrast with the color of exposed rock and soil and presence of streams and lakes provides the essential elements of quality western mountain scenery. Intrusive land patterns are relatively few such as highways and power lines, while farming and grazing patterns add to rather than detract from the scenic qualities. Wildlife present in the area includes mule and whitetailed deer, pronghorn antelope in the grass-shrub areas, elk, moose, an occasional mountain lion, black bear, a few bighorn sheep, blue grouse, ruffed grouse, sage grouse at lower elevations, chukkar partridge in the southern area, coyote, bobcat, red fox and, rarely, Canada lynx throughout the area.

The Big Horn Mountains in this part of the study area may be divided into the following three sections.

The middle section in the north one-half of Johnson County contains the higher scenic qualities associated with Big Horn Mountain scenery having steep slopes, scenic combinations of vegetative cover including alpine, numerous mountain lakes and streams, mountain meadows, peaks in excess of 10,000 feet on Big Horn Divide including spectacular Cloud Peak with an elevation of 13,175 feet, glacial cirques and deep U-shaped valleys, timberline qualities, and Powder River Pass at elevation 9,666 feet.

The northern section of Sheridan County, while not as spectacular as the foregoing, has the same general qualifications such as the timberline and the Big Horn Divide as well as the high mountain, Baldy, and Granite Passes.

The southern section in Johnson and Natrona Counties is a transition area to the rolling broken lands of Great Plains extension into the Wyoming Basin. The elevation is lower and grass-shrub combinations become more dominant. Scenic attractions include the southern end of the mountains with many incised small stream drainages.

Southern Rocky Mountains.

The Southern Rocky Mountains in the study area are represented by the extreme northern end of the Laramie Range in Natrona County. These mountains are much lower in elevation than the Big Horns and in this area do not have spectacular peaks. Their scenic qualities are due to the heavily wooded cover on the steep side slopes which extend over the tops, opening into pleasant grassy meadows.

Features of the area are Casper Mountain south of that city and Muddy Mountain south and east of Casper Mountain. These mountains have broad rolling tops and are much used by local residents for recreational activities. Casper Mountain has considerable development for these activities. The other principal land pattern is grazing.

Wyoming - Big Horn Basins.

This extension of the Northern Great Plains becomes a part of the rolling dry, colorful Wyoming Basin. The scenic aspects are quite varied due to the level to gently rolling river bottoms, buttes, escarpments and the highly colored shales exposed on steep banks and hillsides.

Land patterns include some irrigated croplands, highways and trails, transmission lines, grazing, oil, gas and mining - both

surface and underground - and Grey Reef, Alcova, and part of Pathfinder Reservoirs on the North Platte River.

Dominant vegetative cover is sagebrush and mixed-prairie grasses with some deciduous trees and shrubs along the rivers and sparsely scattered conifers on ridge slopes. Wildlife in this subdivision includes mule deer, pronghorn antelope, a small bighorn sheep population in the Rattlesnake Range, a few mountain lion, sage grouse, Hungarian partridge, coyote, bobcat and red fox.

Specific areas of scenic interest include the following.

The North Platte River provides the scenic attraction of a flowing stream along with its colorful enclosing bluffs and escarpments of red shales such as at Bessemer Bend and the precipitous narrow walled Fiery Narrows and Fremont Canyon between Alcova and Pathfinder Reservoirs.

The Red Wall, in association with Hole in the Wall country in southwest Johnson County, is another example of the brilliant reds of exposed shales in an escarpment following the Big Horn Mountains for about 100 miles.

Hells Half Acre in northwestern Natrona County is deeply eroded badlands of caverns, crevices, spires, towers and buttresses carved by wind and water out of the shales and sandstones in this relatively level plain.

The Rattlesnake Range in western Natrona County is comprised of low hills providing a visual contrast in this undulating plains country.

Wyoming Summary.

The following subdivisions, categories, and/or features are considered to possess high scenic values within the Wyoming study area. These areas are not listed in any ranking order.

Ponderosa Pine Country

Black Hills including Devils Tower Area

Big Horn Mountains

Red Wall.

Bibliography

Land Use Consultants. 1971. A planning classification of Scottish Landscape Resources. CCS Occas. Pap. 1. Publ. by Countryside Com. for Scotland, Battleby, Perth. 73 p. illus. 5 append.

USDI Geological Survey. 1970. National Atlas of the United States of America. 417 p., illus.

Alsberg, Henry. 1950. North Dakota; American Guide Series--A Guide to the Northern Prairie State. Compiled and written by the Fed. Writ. Proj. 352 p., illus.

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FOREST PRODUCTS

1. INTRODUCTION

The Northern Great Plains Resources Program study area includes a substantial acreage of commercial forest land and a significant volume of wood usable for forest products. Generally, the areas of commercial forest land occur at higher elevations (for example, between 7,000 and 10,000 feet in Wyoming) and tend to be quite scattered, including many acres of "stringers and patches." Much of the study area has a relatively dry climate and a fairly short growing season, factors that contribute to a medium to low productivity rating for much of the commercial forest land.

Forest products include principally saw logs, pulpwood, mine timbers, posts, fuelwood, and miscellaneous farm timbers. Of these products, saw logs are by far the most dominant, giving rise to a locally important lumber industry. Primary wood-using industries, mostly sawmills, tend to be scattered, with the larger mills located near larger areas of commercial forest land.

II. PROCEDURES

In 1969-1970 the Forest Survey Research Work Unit of the Intermountain Forest and Range Experiment Station (Forest Service, U.S. Department of Agriculture) conducted a timber removals study in the Rocky Mountain States, including Montana, South Dakota, and Wyoming. During the course of the study, all known primary wood-using industries in these States were contacted for the volumes and kinds of forest products they produced in 1969, and the counties in which these products originated. These data were used to prepare the county estimates shown for Montana, South Dakota, and Wyoming (Table 1).

For North Dakota, similar data based on a similar study were made available by the North Dakota Forest Service and the North Central Forest Experiment Station (Table 1).

Commercial forest land acreages were developed by the Forest Survey Research Work Unit of the Intermountain Station based on inventories conducted in the respective States. Information for North Dakota was furnished by the North Central Station.

III. RESULTS

Fifty-four of the 63 counties in the Northern Great Plains Resource Program study area contain commercial forest land totaling 2,712,010 acres. If the counties with 10,000 acres or less of commercial forest land were excluded, only 24 counties would be listed.

Three counties in Montana, four in North Dakota, one in South Dakota, and five in Wyoming contain 1,853,000 acres of commercial forest land supporting about 2.19 billion cubic feet of growing stock. These are the counties that rather consistently report forest products output (Setzer, 1970). This output for 1969 was 9,945,000 cubic feet (Setzer 1971a, 1971b). Over the years a few other counties have reported products output (for example, Big Horn County, Montana) but generally volumes are small and output sporadic.

The area and volume figures do not adequately describe the nature of the forest resources. For example, commercial forest land is widely scattered and includes many acres capable of producing 50 cubic feet per acre per year or less. While this level of productivity may be considered low nationally, it probably approximates the average productivity for the study area, where about 85 cubic feet per acre per year could be considered fairly high. Volumes per acre of merchantable trees are often low, making harvesting somewhat tedious. Often, a large area of land is necessary to support a primary wood-using industry of even modest size. Low annual precipitation and/or short growing seasons normally tend to limit timber-growing opportunities.

Within the surface resources study area, the most significant primary wood-using industry consists of a scattering of sawmills. Most of the mills produce less than 1 million board feet of lumber annually. A few produce between 5 and 10 million board feet, and 2 in Wyoming produce between 10 and 20 million board feet annually (1969-70 data). Presently, a third mill in Wyoming is producing between 10 and 20 million board feet, having moved up from a lower production class. There are also several post- and pole-producing plants and some fuelwood suppliers. Production data indicate that the forest industry consists mainly of processing saw logs. Of the forest products output, saw logs account for more than 95 percent of the volume. Great distances to veneer and pulpwood markets undoubtedly militate in favor of saw log processing, though some pulpwood is shipped to Lake States users.

Counties having significant products output are usually those having the largest acreages of commercial forest land. As mentioned before, some counties other than those shown as producers in 1969-70 have in past years reported output of various products, and some have supported small sawmills. Since some counties not reporting products output do contain commercial forest land, they may again in the future be a source of roundwood[1/].

1/ Commercial forest land areas and volumes of growing stock of all counties in the study area are shown in the Land Resources Report.

Area, volume, and industry data are for 1969-70. The known changes that have taken place since then involve mostly production variations and industry ownership.

The output of a number of products was very small. To avoid "losing" this volume, and also to avoid disclosing any individual industry's production, this output was combined with that of other "minor" products.

Included in the accepted definition of commercial forest land is reference to a production capability of 20 cubic feet per acre per year or more of industrial wood. The 1,853,000 acres of commercial forest land within the 13 counties reporting products output in 1969 theoretically are producing in excess of 37,000,000 cubic feet per year. Even after allowing for mortality, it would appear reasonable to assume that the present 10 million cubic foot products output could be increased considerably as markets develop.

Pulpwood production has increased slightly. This product would undoubtedly experience a substantial rise in output if any of the numerous pulpmill feasibility studies conducted in the past actually resulted in the establishment of a pulpmill somewhere in the area.

At least one plywood feasibility study has been conducted; conclusions were that sufficient volumes of veneer logs are available to support a plant, probably in the Black Hills area.

Northern Great Plains Resources Program
Surface Resources Work Group

Table 1.--Output of roundwood products from timberlands in the NGPRP study area, by state, selected counties, and products

State	County	Total output all products	Saw logs	Posts fuelwood & misc. farm timbers	Misc. industrial wood	Commercial forest land	Growing stock volume
		- - - - Thousand cubic feet-			- - -	Thousand acres	Thousand cubic feet
Montana							
	Musselshell	241	237	2	2	175	189,683
	Powder River	361	355	3	3	181	93,813
	Rosebud	265	260	2	3	177	210,381
	Total	867	852	7	8	533 1/	493,877
North Dakota							
	Emmons	41	35	-	6	4	2,698
	McLean	176	150	-	26	7	4,596
	Sheridan	176	150	-	26	1	599
	Williams	53	45	-	8	1	599
	Total	446	380	-	66	13	8,492
South Dakota							
	Meade	502	380	89	33	70	49,942
	Total	502	380	89	33	70 2/	49,942
Wyoming							
	Converse	120	117	2	1	127	149,503
	Crook	2,687	2,619	43	25	474	531,848
	Johnson	2,179	2,124	35	20	240	394,058
	Sheridan	2,451	2,389	39	23	259	420,716
	Weston	693	676	11	6	137	142,708
	Total	8,130	7,925	130	75	1,237 3/	1,638,833
	Total all states	9,945	9,537	226	182	1,853	2,191,144

1/ Does not include 37,997 acres of unregulated and 36,170 acres of deferred commercial forest land in National Forests.

2/ Does not include 1,800 acres of unregulated commercial forest land in National Forests.

3/ Does not include 7,863 acres of unregulated and 6,774 acres of deferred commercial forest land in National Forests

Northern Great Plains Resources Program
Surface Resources Work Group

Table 2.--Numbers and kinds of primary woodusing industries in the Northern Great Plains Resource Program study area, by State and County, 1969-1970.

State	County	Industry	Number
Montana	Carter	Sawmill	1
	Musselshell	Sawmill	3
		Post and pole	1
	Powder River	Sawmill	1
	Rosebud	Sawmill	3
	Yellowstone	Post and pole	1
North Dakota	Emmons	Sawmill	1
	McLean	Sawmill	1
	Sheridan	Sawmill	1
	Williams	Sawmill	1
South Dakota	Meade	Sawmill	2
Wyoming	Converse	Sawmill	3
	Crook	Sawmill	4
		Post and pole	1
	Johnson	Sawmill	5
	Sheridan	Sawmill	1
	Weston	Sawmill	5

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BIBLIOGRAPHY

Setzer, Theodore S.
1970. Timber Products In The Rocky Mountain States, 1966. USDA For. Serv. Resour. Bull. INT-9, 89 p.

Setzer, Theodore S.
1971a Estimates Of Timber Products Output And Plant Residues, Montana, 1969. USDA For. Serv. Res. Note INT-133, 4 p.

Setzer, Theodore S.
1971b. Estimates Of Timber Products Output and Plant Residues, Wyoming and Western South Dakota, 1969. USDA For. Serv. Res. Note INT-136, 6 p.

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SURFACE REHABILITATION POTENTIALS AND LIMITATIONS

I. INTRODUCTION

The Fort Union region, the largest in the Northern Great Plains coal province, encompasses the western half of North Dakota and parts of South Dakota and Montana. It contains an estimated 440 billion tons of lignite, by far the largest coal resource in the entire United States (Landis, 1973). Most of the coal occurs in the Ludlow, Tongue River, and Sentinel Butte members of the Fort Union formation. The coalbeds are discontinuous and vary greatly in thickness. More than a hundred coalbeds have been identified, but no more than three beds of commercial thickness have been found in any one section. Most coal throughout the Fort Union region is lignite. The Powder River region is the southern extension of the Fort Union region, and it extends from southern Montana into northeastern Wyoming. This region contains nearly 240 billion tons of subbituminous coal (Glass, 1972).

These formations consist of from 1,700 to 3,200 feet of sandstone, shale, and coal. The thickest coalbeds are in the Wyoming part of the region. Some of the most important coalbeds are the Badger and School seams at Glenrock, the Monarch seam near Sheridan, the Healey bed near Lake Desmet, and the famous Wyodak bed near Gillette.

Bentonite clay beds occur at various locations in southeastern Montana, northeastern Wyoming, and the western Dakotas. The most extensive bentonite beds and the greatest mining activity occur near the three-state juncture of South Dakota, Wyoming, and Montana.

Adverse effects on the environment resulting from surface mining of coal are major national concerns. Americans are rapidly becoming aware that the environment cannot be taken for granted because the quality of life is directly related to the quality of the environment. Ever-increasing demands for coal as a primary energy source, coupled with technological advancement in extraction techniques, have led to increased surface mining of coal. Mining and processing coal for energy utilization has often resulted in what is now perceived as unacceptable degradation of the environment. Effects on the environment have varied, but, mainly, in degree rather than kind. Surface mining for coal has not been a major contributor to air pollution. However, processing coal by combustion to produce energy has resulted in major air pollution because of stack emissions. Surface mining has produced most noticeable impacts on the land. Vegetation has been destroyed, soils turned upside down, and large areas left as bare, unsightly, spoil banks. Natural topography and beauty have been greatly altered. Some of these areas have lost their productivity. Only a small percentage of strip-mined lands has been restored. Surface mining for coal has polluted surface and ground water resources in those parts of the country where the coal has a high sulfur content. Fortunately, the magnitude of the impacts which surface mining for coal in the Northern Great Plains is expected to have on water resources is less serious than that experienced elsewhere, especially in the eastern coalfields.

Various actions can be taken to mitigate the undesirable environmental impacts of surface mining in the Northern Great Plains.

Foremost is planning when, where, and how much coal or other mineral resources are to be mined consistent with the management of other resources, giving due consideration to community, regional, and national social and economic needs. Another way to minimize undesirable environmental impacts of surface mining is to incorporate environmental protection requirements in prospecting and mining leases. A primary means of mitigating the physical impacts of coal mining is through the operational techniques employed. Adequate supervision of mining operations is another way to insure that adverse mining impacts will be minimal. Finally, another way of mitigating the undesirable effects of surface mining is by rehabilitating the disturbed areas.

Rehabilitating surface mined lands involves the shaping of spoil piles to desirable configurations, the application of available surface soil, and the planting of suitable vegetation. Major factors influencing the success of the surface mined rehabilitation program are the chemical, hydrologic, and physical characteristics of reshaped spoil materials as they influence productivity; the climatic characteristics of the site reflected by amounts and distribution of precipitation and the potential for evapotranspiration; and the availability of adequate seeds and propagated plant parts of both native and suitable introduced plant species. Current rehabilitation concepts entail returning sites to as nearly as possible their original form. Hills and valleys are created to provide the same

variety in the landscape as occurs naturally. On drier sites, irrigation may be utilized to facilitate better or more rapid response of seeded or planted vegetation. Land disturbance involved in rehabilitation treatments often creates conditions conducive to wind and water erosion. Soil may be compacted by some of the operations. Sediment levels in streams may be temporarily increased. However, environmental impacts from rehabilitation treatments are generally short-term tradeoffs that are necessary to reestablish vegetation and return sites to their former or higher productive capacities, to their original or improved vegetation covers, and to their former or more suitable land uses.

The objectives of this regional profile report are to:

1. Summarize pertinent information about the Northern Great Plains study area and selected locales therein relative to the important factors that affect rehabilitation potentials of surface mined lands. While it is recognized that numerous factors exert influences on rehabilitation potentials, including climate, geology, physiography, soils, availability of adaptable vegetation, mining techniques, and post-mining methods for handling spoils, the short time period for this study, together with the extreme recency of expanded surface mining in the Northern Great Plains, combine to limit consideration to only those few factors which bear most on surface mine rehabilitation potentials.

2. Arrange the most important factors into a system to delineate and classify surface minable lands into rehabilitation response units according to their potential capabilities for responding to rehabilitation treatments.
3. Locate and classify each of the existing surface mines in the Northern Great Plains within its appropriate rehabilitation response unit.
4. Describe the history of rehabilitation efforts and success of each of the existing mines for which information is available.
5. Determine the areas of the different rehabilitation response unit by states and counties, by alternative coal development forecasts, and by years.
6. Develop rating criteria and rate the relative rehabilitation potentials of the various response units.
7. Weight each of the rehabilitation response unit ratings by the percentage of surface minable land occupied by the appropriate rehabilitation response unit. This provides a relative rehabilitation potential rating for the response unit.
8. Relate the relative rehabilitation ratings to the degree of rehabilitation success or failure experienced on individual mines to arrive at an absolute qualitiative rating of rehabilitation response units comprising the surface minable lands of the Northern Great Plains.

9. Indicate the nature of research and other problems relating to rehabilitation potentials which need further study.

Because of the time constraints and the lack of detailed information on results of rehabilitation efforts on the relatively new mines in the Northern Great Plains, it is not expected that the predictive capability derived by this study will be useful on a site specific basis. Rather, results of this study will be more useful for predicting potential rehabilitation success on larger tracts of land characterized by soil associations, broad vegetation types, and average annual precipitation characteristics. Site specific information regarding these influencing factors are required to produce site specific rehabilitation prescriptions.

III. RESULTS

Regional Characteristics of Important Factors Affecting Rehabilitation Potentials

As previously stated, the important factors that determine the probabilities for successfully rehabilitating surface mined land in the Northern Great Plains are the amount and distribution of precipitation, the productivity and stability of soils, and the suitability and availability of different plant species having desirable characteristics.

The Northern Great Plains coal province has a semiarid continental climate. Thornthwaite (1931) has said: "In a desert, you know what to expect of the climate and plan accordingly. The same is true of the humid regions. Men have been badly fooled by the semiarid regions because they are sometimes humid, sometimes desert, and sometimes a cross between the two. Yet, it is possible to make allowances for this too, once the climate is understood." The climate of a region cannot be fully described by such a single element as precipitation or temperature. Climate is comprised of such numerous elements as precipitation, air temperature, soil temperature, humidity, wind velocity, atmospheric pressure, solar terrestrial radiation, and snow cover. However, usually in any particular region, only one or two climatic elements exert preponderant influence in determining the nature of the climate. In the semiarid Northern Great Plains,

the single most important climatic element that determines relative agricultural success is the amount of seasonal precipitation, coupled with its distribution pattern (Thornthwaite, 1941).

A great difference exists in this area in the frequency of occurrence of the various climatic types, as is indicated in Table 1.

Table 1.--Climatic variability in the Northern Great Plains based on effective precipitation as determined in Thornthwaite's (1941) classification of climates

Length of record (years)	Climatic type	Climatic distribution (years)
37	Semiarid	Superhumid (0) Humid (1) Moist subhumid (1) Dry subhumid (5) Semiarid (25) Arid (5)

In some years, the amount and seasonal distribution of rainfall in the Northern Great Plains is entirely adequate for successful agriculture; in others, the rainfall is so reduced that successful crop production is unlikely. No corresponding risk exists in a continuously arid climate because in no year does the weather encourage an attempt at agriculture. In the Northern Great Plains, precipitation surpasses that of the semiarid climates with sufficient frequency to encourage agricultural endeavors, but not to assure successful agriculture every year.

Average annual precipitation in the Northern Great Plains varies between 8 and 24 inches. The largest portion of the area receives between 10 and 16 inches. More than 90 percent of the surface minable lands in the Northern Great Plains receive between 12 and 16 inches. Precipitation is greatest along the eastern boundary of the region in western North Dakota and in the Black Hills of South Dakota. It is least in northeastern Wyoming and northeastern Montana. Precipitation throughout the region is heaviest in the April to September period, when up to 75 percent of the annual amount occurs. The summer rains are usually out of the south from the Gulf of Mexico, and are mostly in the form of thunderstorms. The prevailing wind pattern is from the west or northwest. The western portion of the area is noted for its wind, which quickly dries soils out in the summer and drifts snow in the winter. The area normally receives less than 1 inch of precipitation per month in the winter. The lines of equal precipitation (isohyetal lines), although subject to some meandering, are oriented north-south, so that a generalization is that precipitation increases about an inch for every fifty miles of movement eastward. During the growing season, distribution of precipitation is usually favorable for crop production. Rainfall in the spring is light. It increases from April until September, when it is needed most for vegetative growth. From September until December, declining precipitation--along with abundant sunshine--favors maturing of both

native and planted crops. A difference of only 1 or 2 inches of rainfall during the growing season may not seem very great, but it can affect significantly the potential for rehabilitating surface mined lands.

The distribution of average annual precipitation in relation to the surface minable lands of the Northern Great Plains coal province is shown in Appendix E, Plate 7. Areas of different precipitation zones comprising surface minable lands by states and counties are shown in Table 2.

Soil Productivity and Stability Characteristics. Soils of the Northern Great Plains resources study area have been described and characterized by the Soils Work Group. No effort will be made here to recharacterize these soils completely; however, the productivity and stability characteristics of those soils that occupy the surface minable lands of the study area will be described briefly.

Forty-two major soil associations are identified within the boundaries of the Northern Great Plains resources study area. These soil associations are depicted on Aandahl's map entitled, "Soils of the Great Plains," and are also shown in Appendix E, Plate 7. Of these 42 soil associations, only 17 occupy those surface minable areas delineated by the Mineral Resources Work Group. These 17 soil associations, therefore, are the only ones considered in this report.

Table 2.--Areas of different precipitation zones comprising surface minable lands by state and counties in the Northern Great Plains resources study area

Precipitation zone	Wyoming		Montana		No. Dakota		So. Dakota	
	County	Acres	County	Acres	County	Acres	County	Acres
Inches								
<12	Campbell	35,386						
State subtotal		35,386						
12	Converse	17,382	Musselshell	7,450				
	Campbell	76,358	Garfield	278,118				
			McCone	99,328				
			Richland	64,563				
			Dawson	12,416				
State subtotal		93,740		461,875				
13	Converse	19,866	Treasure	24,832				
	Campbell	32,282	Musselshell	2,483				
			Custer	32,282				
			Fallon	34,765				
			Richland	17,382				
			Dawson	12,416				
			Sheridan	32,282				
			Roosevelt	17,382				
State subtotal		52,148		173,824				
14	Converse	7,450	Rosebud	7,450	Williams	12,416	Butte	52,147
	Campbell	22,349	Big Horn	39,731	Slope	24,832		
			Treasure	4,966	Golden Valley	37,248		
			Custer	17,382				
			Wibaux	44,698				
			Richland	7,450				
State subtotal		29,799		121,677		74,496		52,147

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Table 2 (Cont'd)

Precipitation zone	Wyoming County	Wyoming Acres	Montana County	Montana Acres	No. Dakota County	No. Dakota Acres	So. Dakota County	So. Dakota Acres
Inches								
15	Campbell	29,798	Powder River	139,059	Mercer-Oliver	47,181	Meade	76,979
	Sheridan	37,248	Rosebud	19,866	McLean	9,933		
	Johnson	39,731	Big Horn	166,374	Ward	7,450		
			Custer	39,731	Burke	22,349		
					Williams	9,933		
					Dunn	22,349		
					Billings	22,349		
					Stark	62,080		
					Bowman	22,349		
					Slope	52,147		
State subtotal		106,777		365,030		278,120		76,979
16	Campbell	89,395	Powder River	81,946	Mercer-Oliver	91,878		
			Rosebud	94,362	McLean	9,933		
			Big Horn	2,483	Burleigh	7,450		
					Ward	9,933		
					Stark	34,765		
					Slope	37,248		
					Adams	49,664		
					Hettinger	109,261		
State subtotal		89,395		178,791		350,132		
>16	Weston	14,899	Powder River	22,349				
			Rosebud	22,349				
State subtotal		14,899		44,698				
State totals		422,144		1,345,895		702,748		129,126

Ten of these 17 soil associations are classified on Aandahl's soils map of the Great Plains as typic (moderately moist) Borolls (which have a horizon of clay accumulation sometimes containing sodium) and Ustorthents (which are sometimes dry, sometimes moist, receive summer rains, but lack moisture for plant growth for long periods). These ten soil associations are located primarily in the western North Dakota portion of the study area, and are identified on Aandahl's soil map by soil association numbers: 19, 23, 25, 26, 27, 30, 31, 33, 34, and 35.

One soil association, 44, is classified as Borollic (cold), Torriorthents (nearly always dry) Natrargids (having much sodium on the clays). This soil association occurs chiefly across the dry central-eastern plains of Montana and the extreme northwest corner of South Dakota.

Five soil associations, numbers 109, 111, 117, 121, and 123, are classified as Ustic (alternately moist and dry), Aridisols (low in organic matter and usually dry), Camborthids-Haplargids (little or no soluble salts or sodium clays). These soil associations are found in southeastern Montana, northeastern Wyoming, and western North Dakota.

The remaining soil association, number 184, is classified as a badlands Torriorthent (rocky and dry). This soil association is found in only a few places on the extreme fringe of surface minable lands in the Badlands along the Little Missouri River in western North Dakota.

These 17 soil associations are characterized with respect to their productivity for growing vegetation and their stability against erosive forces as follows:

Soil Association 19. A fine Argiboroll having a layer of clay accumulation in the C horizon; productive capability is good; occurs on level-to-undulating topography having slopes generally less than 8 percent; very good stability.

Soil Association 23. A fine loamy Argiboroll occupying drier sites than soil association 19, but it still has good productivity; occurs on level-to-undulating topography; good stability.

Soil Association 25. A loamy Argiboroll and is probably the most productive one of the 17 soil associations; occurs on level-to-rolling topography up to slopes of 16 percent; good stability.

Soil Association 26. A fine loamy Argiboroll; has good productivity; occurs on level-to-rolling topography having slopes up to 16 percent; good stability.

Soil Association 27. A clayey and fine loamy Argiboroll; fairly good productivity; level-to-rolling topography having slopes up to 16 percent; fairly stable.

Soil Association 30. A loamy and sandy Haploboroll without any distinct accumulation of calcium carbonate, clay, or sodium; fairly good productivity; level-to-rolling topography with slopes up to 16 percent; fairly good stability.

Soil Association 31. A fine loamy and loamy skelatal lithic Haploboroll; fair productivity; undulating-to-hilly topography having slopes of up to 30 percent; poor stability.

Soil Association 33. A fine silty and fine loamy Haploboroll; fair productivity; undulating-to-hilly topography having slopes up to 30 percent; poor stability.

Soil Association 34. A fine loamy Ustortent having a horizon of heavy clay accumulation; fair productivity; undulating-to-hilly topography having slopes up to 30 percent; poor stability.

Soil Association 35. A shallow loamy Usthorthent having a horizon of heavy clay accumulation; fair productivity; undulating-to-steep topography having slopes in excess of 30 percent; very poor stability.

Soil Association 44. A shallow and loamy Borollic Torriorthent having a large amount of sodium on the clays; fairly poor productivity; undulating-to-hilly topography having slopes up to 30 percent; fairly poor stability.

Soil Association 109. A clayey and loamy Ustic Aridisol having a horizon with an accumulation of very active or swelling clays; very poor productivity; undulating-to-rolling topography having slopes up to 16 percent; fair stability.

Soil Association 111. A shallow clayey Ustic Aridisol having a horizon with a heavy accumulation of active or swelling clays; poor productivity; undulating-to-hilly topography having slopes up to 30 percent; fairly poor stability.

Soil Association 117. A clayey and loamy Ustic Aridisol having a large amount of sodium on the clays; poor productivity; undulating-to-rolling topography having slopes up to 16 percent; fair stability.

Soil Association 121. A shallow, loamy and clayey Ustic Aridisol which is dry much of the year; very poor productivity; rolling-to-steep topography having slopes in excess of 30 percent; very unstable.

Soil Association 123. A shallow, loamy and clayey Ustic Aridisol which is dry much of the year and which has a large amount of sodium on the clays; very poor productivity; undulating-to-hilly topography having slopes up to 30 percent; poor stability.

Soil Association 184. A loamy and clayey badlands Torriorthent which is dry much of the year; very poor productivity and it occurs on undulating-to-steep badlands having slopes in excess of 30 percent; very poor stability.

Soil tests and field trials indicate that soils in Montana and Wyoming and west of the Missouri River in North Dakota are conspicuously deficient in phosphorus. Response to phosphorus fertilizer is less consistent in the drier western part of the region than in the more moist regions east of the Missouri River in North Dakota. Nitrogen is generally more deficient in the moister part of North Dakota than it is in eastern Montana or eastern Wyoming. Where nitrogen is deficient, little or no response is obtained from phosphate fertilizer unless nitrogen is also provided.

Erosion is a serious problem in some localities of the Northern Great Plains resources study area. Sandy soils are

especially subject to erosion because they contain insufficient silt and clay to form large aggregates resistant to wind and water erosion. Repeated freezing and thawing and wetting and drying are conducive to erosion because of the formation of aggregates of the size susceptible to wind and water actions. Soils high in clay are most subject to this type of erosion. Areas of the different soil associations occupying surface minable lands by states and counties are shown in Table 3.

Table 3.--Areas of different soil associations occupying surface minable lands by states and counties in the Northern Great Plains Resources study area

Soil association	Wyoming County	Wyoming Acres	Montana County	Montana Acres	No. Dakota County	No. Dakota Acres	So. Dakota County	So. Dakota Acres
35			Wibaux	7,450	Mercer-Oliver	59,596		
			Richland	7,450	Williams	19,866		
					Slope	29,798		
					Stark	19,866		
State subtotal				14,900		129,126		
44			Custer	17,382			Butte	37,248
			Fallon	34,765				
			Garfield	193,690				
			McCone	74,496				
State subtotal				320,333				37,248
109							Meade	76,979
State subtotal								76,979
111							Butte	14,899
State subtotal								14,899
117	Converse	29,798	Powder River	14,899				
	Campbell	196,173	Big Horn	104,294				
	Johnson	17,382						
State subtotal		243,353		119,193				

Table 3 (Cont'd)

Soil association	Wyoming County	Wyoming Acres	Montana County	Montana Acres	No. Dakota County	No. Dakota Acres	So. Dakota County	So. Dakota Acres
19					Mercer-Oliver	34,765		
					McLean	9,933		
					Burleigh	7,450		
					Ward	17,382		
					Burke	22,349		
					Williams	2,483		
State subtotal						94,362		
21					Mercer-Oliver	7,450		
					McLean	9,933		
State subtotal						17,383		
23			Sheridan	12,416	Mercer-Oliver	24,832		
State subtotal				12,416		24,832		
24					Dunn	4,966		
					Billings	22,349		
					Stark	49,664		
					Bowman	4,966		
					Slope	34,764		
State subtotal						116,689		
25	Sheridan	27,315	Big Horn	29,798	Mercer-Oliver	12,416		
					Bowman	17,382		
					Slope	47,181		
					Stark	14,899		
					Adams	7,450		
					Hettinger	94,362		
State subtotal		27,315		29,798		193,690		

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Table 3 (Cont'd)

Soil association	Wyoming County	Wyoming Acres	Montana County	Montana Acres	No. Dakota County	No. Dakota Acres	So. Dakota County	So. Dakota Acres
26			McCone	9,933				
			Richland	52,147				
			Dawson	12,416				
			Sheridan	19,866				
			Roosevelt	17,382				
State subtotal				111,744				
27			Wibaux	29,798	Golden Valley	29,798		
State subtotal				29,798		29,798		
30					Dunn	17,382		
					Stark	12,416		
					Adams	42,214		
					Hettinger	14,899		
State subtotal						86,911		
31			Powder Riv.	193,690				
			Rosebud	101,811				
			Big Horn	19,866				
			Custer	54,630				
State subtotal				369,997				
33			Wibaux	7,450	Golden Valley	7,450		
			McCone	4,966				
			Richland	29,798				
			Dawson	12,416				
State subtotal				54,630		7,450		

Table 3 (Cont'd)

Soil Association	Wyoming County	Wyoming Acres	Montana County	Montana Acres	No. Dakota County	No. Dakota Acres	So. Dakota County	So. Dakota Acres
121	Weston	14,899						
State subtotal		14,899						
123	Converse	14,899	Powder River	34,765				
	Campbell	89,395	Rosebud	42,214				
	Sheridan	9,933	Big Horn	54,630				
	Johnson	22,349	Treasure	29,158				
			Musselshell	9,933				
			Custer	17,382				
State subtotal		136,576		188,082				
184			Garfield	84,429	Slope	2,483		
			McCone	9,933				
State subtotal				94,362		2,483		
State totals		422,143		1,345,253		702,748		129,126

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Suitability, Availability, and Characteristics of Native Vegetation Types in the Northern Great Plains

Plants of the Northern Great Plains coal province are mostly such grass species as wheatgrasses, needlegrasses, grama grasses, bluestems, and fescues. Overgrazing by livestock and by buffalo before them have increased sagebrushes and rabbit brushes in these grasslands, especially in the shortgrass prairies. All native grasses in the Northern Great Plains grow well under the favorable precipitation-temperature pattern during the growing season. Some areas of the cold desert biome dominated by sagebrush and the montane coniferous forest biome dominated by ponderosa pine, also occur in the Northern Great Plains. Cottonwood, willow, and ash of the deciduous forest biome dominate the gully bottoms along the rivers and their tributaries. Four-wing saltbush, found along the drainages, and inland saltgrass indicate alkaline or saline areas. Frequently, sand sage and prairie sand reed occupy sandy areas.

The native vegetation types of the Northern Great Plains have been described and characterized by the Ecosystems Subwork Group. Sixteen broad, but recognizable, ecosystems were delineated in the Northern Great Plains resources study area. These are shown in Appendix E, Plate 7. Nine of these 16 vegetation types occur on surface minable areas, and are the only vegetation types which we will consider in respect to rehabilitation potential. A brief description of these nine vegetation types, with respect to the suitability and availability of the plant species, follows. These

vegetation types have the same type identification numbers as those employed by the Ecosystems Subgroup. To permit comparison, the corresponding Kuchler (1964) vegetation type number is also shown.

Flood Plain. (type 1, Kuchler type 98). This type occurs on major river bottoms and banks and on broad flood plain terraces having alluvial soils. It occupies sites with high water tables, and some are highly saline. It is characterized predominantly by hardwood tree and shrub species that are poorly suitable and poorly available for rehabilitation. A list of characteristic plant species for this and each subsequent vegetation type appears in the Ecosystems Subgroup report.

Badlands. (type 2). This type occupies breaks along rivers and streams and steep south slopes of exposed shales, sandstones, and clays. Predominant plant species are arid land shrubs and grasses associated locally with scabby ponderosa pine forests. The species that characterize this type are poorly suitable and scarcely available for rehabilitation.

Shortgrass Prairie. (type 3, Küchler type 64). This type consists of dry prairies on shallow soils in southeastern Montana and northeastern Wyoming. Predominant species are blue grama grass, western wheatgrass, and various needlegrasses. The species that characterize this type have moderately poor suitability and fair availability for rehabilitation.

Mid-Shortgrass Prairie. (type 4, Küchler types 64 and 66). This type consists of rolling prairie on loam to clay loam soils in eastern Montana. It is characterized by western wheatgrass, needle-and-thread, and blue grama. These species are moderately to poorly suitable with fair availability for rehabilitation.

Mid-Grass Prairie. (type 5, Küchler type 66). This type, which occurs on loamy soils in extreme eastern Montana, southwestern North Dakota, and northwestern South Dakota, contains no dominant short grass. Principal species are needlegrasses, wheatgrasses, and blue stem. Most species comprising this type are suitable and available for rehabilitation.

Grassland-Sagebrush. (type 6, Kuchler type 56). This type consists of open grassland of mid- and short-grasses, with scattered sagebrush, and occurs on silty clay loam soils in southeastern Montana and northeastern Wyoming. Most of the species that comprise this type are suitable and moderately available for rehabilitation.

Sagebrush-Steppe. (type 7, Küchler type 55). This type is dominated by sagebrush in open grassland containing wheatgrasses and needle-and-thread on silt to silty clay loam soils. It occurs chiefly in northeastern Wyoming and most of the major species are suitable but relatively unavailable for rehabilitation.

Mid-Tall Grass Prairie. (type 9, Küchler type 67). This type occurs on gently rolling prairie northeast of the Missouri River in

North Dakota, and is characterized by wheatgrasses, big and little blue stem, and needlegrasses on loam soils of glacial till origin. Nearly all of the species in this type are suitable and available for rehabilitation.

Ponderosa Pine Forest. (type 12, Küchler type 16). This type occurs mainly in eastern Montana and northeastern Wyoming on upland, ridges, and north slopes having shallow loam soils. Prominent species are ponderosa pine, snowberry, blue grasses, fescues, and June grass. These species are only fairly suitable but readily available for rehabilitation.

These native vegetation types and their species represent the potential for reestablishment of native plant cover on surface mined areas where surface soil replacement has been achieved. In some portions of the Northern Great Plains, where higher precipitation and more fertile soils occur, lands that are surface mined may be restored to agricultural uses other than the native cover types of the area. In some instances, surface mined lands may lend themselves to such other uses as the development of parks, lakes, marshes, or woodlands. These opportunities require careful planning of mining and post-mining activities. Where such opportunities occur, they should be developed. Except for rehabilitating agricultural lands--largely in North Dakota--and except for occasional specialized reclamation opportunities, the greatest potential for rehabilitating surface mined lands in the study area

lies in using native vegetation species that characterize each area. Areas of different vegetation types occupying surface minable lands by states and counties are shown in Table 4.

Development of Rehabilitation Response Units as a System for classifying rehabilitation potentials on surface mined lands.

In developing this report, we have assumed, with good reason, that within the constraints of time, map scale, and detail of information available, the major environmental factors influencing the potential for rehabilitating surface mined land in the Northern Great Plains are the productivity and stability characteristics of surface soil materials, the suitability of native plant species for plant cover reestablishment and their availability for that purpose, and the amount and distribution of precipitation. The surface minable lands in the Northern Great Plains resources study area occur in 17 soil associations, in nine broad vegetative types, and in seven annual precipitation zones ranging from less than 12 to more than 16 inches by 1-inch increments. If these 17 soil associations, nine vegetative types, and seven precipitation zones occurred together in all possible combinations, they would aggregate 1,071 areas--each differing from all others. All of these possible combinations do not occur on the surface minable lands in the Northern Great Plains. Rather, these factors combine to delineate 86 different combinations on the ground. Thus, the surface minable area in the Northern Great Plains can be divided into 86 different kinds of land,

Table 4.--Areas of different vegetation types occupying surface minable lands by states and counties in the Northern Great Plains Resources study area

Vegetation type	Wyoming		Montana		No. Dakota		So. Dakota	
	County	Acres	County	Acres	County	Acres	County	Acres
1	Sheridan	7,450	Rosebud	7,450	Mercer-Oliver	12,416		
			Big Horn	4,966				
State subtotal		7,450		12,416		12,416		
2			Wibaux	2,484	Slope	2,483		
			Garfield	49,664				
			McCone	4,966				
State subtotal				57,114		2,483		
3	Weston	14,899	Powder River	44,698				
			Custer	64,563				
			Fallon	24,832				
State subtotal		14,899		134,093				
4			Rosebud	14,899				
			Big Horn	44,698				
			Treasure	29,798				
			Custer	4,966				
			Fallon	9,933				
			Garfield	196,173				
			McCone	59,597				
			Richland	7,450				
			Dawson	7,450				
State subtotal				374,964				

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Table 4 (Cont'd)

Vegetation type	Wyoming County	Wyoming Acres	Montana County	Montana Acres	No. Dakota County	No. Dakota Acres	So. Dakota County	So. Dakota Acres
5	Johnson	9,933	Sheridan	32,282	Mercer-Oliver	126,643	Butte	52,147
			Roosevelt	17,382	McLean	19,866	Meade	76,979
			Wibaux	42,214	Burleigh	7,450		
			McCone	34,765	Ward	7,450		
			Richland	81,946	Williams	22,349		
			Dawson	17,382	Dunn	22,349		
					Billings	22,349		
					Stark	96,845		
					Bowman	22,349		
					Slope	109,261		
					Golden Valley	37,248		
					Adams	49,644		
					Hettinger	109,261		
State subtotal		9,933		225,971		653,064		129,126
6	Converse	42,214	Powder River	111,744				
	Campbell	176,282	Rosebud	76,979				
	Sheridan	19,866	Big Horn	144,026				
	Johnson	29,798	Custer	7,450				
State subtotal		268,160		340,199				
7	Campbell	96,845	Powder River	14,899				
	Sheridan	4,966						
State subtotal		101,811		14,899				
9					Ward	9,933		
					Burke	22,349		
State subtotal						32,282		

Table 4 (Cont'd)

Vegetation type	Wyoming		Montana		No. Dakota		So. Dakota	
	County	Acres	County	Acres	County	Acres	County	Acres
12	Converse	2,483	Rosebud	44,698	Slope	2,483		
	Campbell	12,416	Big Horn	14,899				
	Sheridan	4,966	Musselshell	9,933				
			Custer	12,416				
			Garfield	32,282				
			Powder River	72,013				
State subtotal		19,865		186,241		2,483		
State totals		422,118		1,345,897		702,748		129,126

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each having its own rehabilitation potential characteristics. Most of these combinations are found in more than one location; thus, the surface minable area of the Northern Great Plains contains a total of 146 such tracts of land. These tracts have been given the name "rehabilitation response units."

Each rehabilitation response unit is identified by three sets of numbers. The first number, containing either two or three digits, refers to the Aandahl soil association number; the second, containing either one or two digits, refers to the vegetation type number; and the third, containing two digits, refers to the precipitation zone in which the unit is located. For example, rehabilitation response unit 117-6-14 is a tract of surface minable land located in Ustic Aridisol soil association 117, on grassland-sagebrush vegetation type 6, in a 14-inch per year precipitation zone. These combined characteristics place this particular kind of rehabilitation response unit in east central Campbell County, Wyoming. Presumably, regardless of location, any two or more rehabilitation response units having the same soil-vegetation-precipitation identifications should exhibit essentially the same response to similar rehabilitation efforts in a comparable time period. The 86 different kinds of rehabilitation response units have been numbered from 1 through 86. The same number on more than one response unit indicates more than one tract of land in that response unit category. All of the rehabilitation response units that comprise the surface minable

lands are shown by location and number in Appendix E, Plate 8. They are also tabulated in Table 5 by number and acreage for states and counties. The total acreage of all rehabilitation response units in the Northern Great Plains resource study area, and, hence, the total surface minable area, is 2,599,913 acres or 4,062 square miles.

Classification of Existing Surface Mines in the Northern Great Plains by Rehabilitation Response Units.

The Mineral Resources Work Group identified 27 coal surface mines and three underground mines in the Northern Great Plains area. Only surface mines were considered in developing this report. Although their proposed locations are known, five of the surface mines are nonexistent; they are being considered for future development. Of the 22 active coal surface mines in the Northern Great Plains resources study area, some have a recent history of rehabilitation efforts. The locations of these surface mines in relation to the rehabilitation response units of the study area are shown in Appendix E, Plate 8.

Table 5.--Kinds and areas of rehabilitation response units on surface minable lands of the Northern Great Plains

State	County	Rehabilitation response unit: Identification no. Soil	Veget.	Precip.	Map location number	Area
						Acres
Wyoming	Campbell	117	6	14	1	14,899
		117	7	16	2	27,315
		117	6	16	3	17,382
		117	7	15	4	14,899
		117	6	12	5	58,976
		117	6	11	6	35,386
		117	6	13	7	27,315
		123	6	15	9	4,966
		123	7	16	8	44,698
		123	7	15	10	9,933
		123	12	11	12	12,416
		123	6	12	13	4,966
		123	6	13	14	4,966
		123	6	14	15	7,450
				Subtotal		285,568
Wyoming	Converse	117	6	13	7	19,866
		117	6	14	1	7,450
		117	6	12	5	2,483
		123	6	12	13	12,416
		123	12	12	11	2,483
				Subtotal		44,698
Wyoming	Sheridan	25	1	15	17	2,483
		25	6	15	19	19,866
		25	12	15	18	4,966
		123	1	15	16	4,966
		123	7	15	10	4,966
				Subtotal		37,248
Wyoming	Johnson	117	5	15	21	7,450
		117	6	15	22	9,933
		123	6	15	9	19,866
		123	5	15	20	2,483
				Subtotal		39,731
Wyoming	Weston	121	3	18	23	14,899
				Subtotal		14,899
				State total		422,144

Table 5 (Cont'd)

State	County	Rehabilitation response unit: Identification no. Soil	Veget.	Precip.	Map location number	Area
						Acres
Montana	Powder River	31	12	15	25	34,765
		31	6	15	26	9,933
		31	6	16	27	47,181
		31	3	15	28	44,698
		31	6	17	29	22,349
		31	12	16	30	34,765
		117	6	15	22	14,899
		123	12	15	24	2,483
		123	6	15	9	17,382
		123	7	15	10	14,899
				Subtotal		243,354
Montana	Rosebud	31	6	16	27	42,214
		31	1	16	33	7,450
		31	12	16	30	27,798
		31	6	17	29	17,382
		123	12	16	35	7,450
		123	6	15	9	9,933
		123	6	16	36	7,450
		123	4	14	37	7,450
		123	4	15	38	7,450
		123	12	15	24	2,483
				Subtotal		144,026
Montana	Big Horn	25	6	15	19	17,382
		25	12	15	18	12,416
		31	6	15	26	12,416
		31	6	16	27	2,483
		31	4	15	39	4,966
		117	6	15	22	96,845
		117	1	15	40	4,966
		117	12	15	41	2,483
		123	6	15	9	14,899
		123	4	14	37	39,731
				Subtotal		208,589
Montana	Treasure	123	4	13	42	24,832
		123	4	14	37	4,966
				Subtotal		29,798
Montana	Musselshell	123	12	12	11	7,450
		123	12	13	43	2,483
				Subtotal		9,933

Table 5 (Cont'd)

State	County	Rehabilitation response unit Identification no. Soil	Veget.	Precip.	Map location number	Area
						Acres
Montana	Custer	31	3	15	28	32,282
		31	3	14	31	14,899
		31	6	15	26	7,450
		44	3	13	46	14,899
		44	12	13	47	2,483
		123	3	14	32	2,483
		123	12	13	44	9,933
		123	4	13	42	4,966
				Subtotal		89,395
Montana	Fallon	44	3	13	46	24,832
		44	4	13	48	9,933
				Subtotal		34,765
Montana	Wibaux	27	5	14	49	29,798
		33	5	14	50	4,966
		33	2	14	52	2,483
		35	5	14	51	7,450
				Subtotal		44,698
Montana	Garfield	44	4	12	53	188,723
		44	12	12	54	4,966
		184	2	12	55	49,664
		184	12	12	56	27,315
		184	4	12	57	7,450
				Subtotal		278,118
Montana	McCone	26	5	12	58	9,933
		33	5	12	59	4,966
		44	5	12	60	19,866
		44	4	12	53	54,630
		184	2	12	55	4,966
		184	4	12	57	4,966
				Subtotal		99,328
Montana	Richland	26	5	12	58	34,765
		26	5	13	61	9,933
		26	4	13	62	7,450
		33	5	12	59	29,798
		35	5	14	51	7,450
				Subtotal		89,395
Montana	Dawson	26	4	13	62	7,450
		26	5	13	61	4,966
		33	5	12	59	12,416
				Subtotal		24,832

Table 5 (Cont'd)

State	County	Rehabilitation response unit: Identification no. Soil	Veget.	Precip.	Map location number	Area
						Acres
Montana	Sheridan	23	5	13	63	12,416
		26	5	13	61	19,865
				Subtotal		32,281
Montana	Roosevelt	26	5	13	61	17,382
				Subtotal		17,382
				State total		1,345,894
No. Dakota	Mercer-Oliver	19	5	16	64	22,349
		19	1	15	65	4,966
		19	1	16	66	2,483
		19	5	15	73	4,966
		21	5	15	67	7,450
		23	5	16	68	24,832
		25	5	16	72	12,416
		35	5	16	69	24,832
		35	5	15	70	29,798
		35	1	16	71	4,966
				Subtotal		139,059
No. Dakota	McLean	21	5	15	67	9,933
		19	5	16	64	9,933
				Subtotal		19,866
No. Dakota	Burleigh	19	5	16	64	7,450
				Subtotal		7,450
No. Dakota	Ward	19	5	16	64	7,450
		19	9	16	74	2,483
		19	9	15	75	7,450
				Subtotal		17,382
No. Dakota	Burke	19	9	15	75	22,349
				Subtotal		22,349
No. Dakota	Williams	19	5	15	73	2,483
		35	5	14	51	12,416
		35	5	15	70	7,450
				Subtotal		22,349
No. Dakota	Dunn	24	5	15	76	4,966
		30	5	15	77	17,382
				Subtotal		22,349

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Table 5 (Cont'd)

State	County	Rehabilitation response unit: Identification no. Soil	Veget.	Precip.	Map location number	Area
						Acres
No. Dakota	Billings	24	5	15	76	22,349
				Subtotal		22,349
No. Dakota	Stark	35	5	16	45	19,866
		24	5	15	76	49,664
		30	5	15	77	12,416
		25	5	16	72	14,899
				Subtotal		96,845
No. Dakota	Bowman	24	5	15	76	4,966
		25	5	15	78	17,382
				Subtotal		22,349
No. Dakota	Slope	24	5	16	85	4,966
		24	5	14	79	12,416
		24	5	15	76	17,382
		25	5	15	78	14,899
		35	5	15	70	17,382
		35	5	14	51	9,933
		35	2	14	81	2,483
		184	12	15	80	2,483
		25	5	16	72	32,282
				Subtotal		114,227
No. Dakota	Golden Valley	27	5	14	49	29,798
		33	5	14	50	7,450
				Subtotal		37,248
No. Dakota	Adams	30	5	16	86	42,214
		25	5	16	72	7,450
				Subtotal		49,664
No. Dakota	Hettinger	30	5	16	86	14,899
		25	5	16	72	94,362
				Subtotal		109,261
				State total		702,748
So. Dakota	Butte	44	5	14	82	37,248
		111	5	14	83	14,899
				Subtotal		52,147
So. Dakota	Meade	109	5	15	84	76,979
				Subtotal		76,979
				State total		129,126

NORTHERN GREAT PLAINS RESOURCES
STUDY AREA..... 2,599,913

Rehabilitation History and Experience on Existing Surface Mines by Response Units

Approximately 27 active or proposed coal surface mines in the Northern Great Plains resources study area are either mining or expect to mine coal in sufficient quantities to warrant concern for reclamation and rehabilitation of the disturbed areas. Five of these 27 mines, shown in Table 6, are only proposed or in the developmental stage, and, hence, have no rehabilitation history.

Table 6.--Proposed or undeveloped major coal surface mines

Mine no.	Name of mine	State	County	Rehabilitation response unit
6	Welch	Wyoming	Sheridan	25-12-15
7	Carter Oil	Wyoming	Campbell	123-12-14
8	Atlantic-Richfield	Wyoming	Campbell	117-6-11
9	Reynolds Metals	Wyoming	Johnson	117-6-15
10	Kerr-McGee Co.	Wyoming	Campbell	117-6-11

Seven of these 27 mines have either been operated in the past or are operating now. However, none of them has a history of rehabilitation sufficiently firm to warrant inclusion in this report. These mines are listed in Table 7.

Table 7.--Major coal surface mines for which no rehabilitation data or experience is available

Mine no.	Name of mine	State	County	Rehabilitation response unit
3	Best Coal Co.	Wyoming	Converse	123-6-10
4	Pacific Power & Light Co.	Wyoming	Converse	123-6-14
16	Reliable Coal	Montana	Musselshell	123-12-12
24	Bonsness Coal	No. Dakota	Burke	19-9-15
25	Underwood Coal	No. Dakota	McClean	19-5-16
26	Husky-Briquetting	No. Dakota	Stark	30-5-16
27	Arrowhead Coal Co.	No. Dakota	Adams	25-5-15

Besides these seven coal surface mines, mine No. 28 (the Hallett Minerals Bentonite Mine in Treasure County, Montana, on rehabilitation response unit 41-3-12) is operating, and has a planned rehabilitation program not yet implemented.

The remaining 15 coal surface mines and three large bentonite mines have all conducted rehabilitation research, or a rehabilitation action program in one degree or another. These mines are listed in Table 8. Their rehabilitation experience or history will be described.

The 15 coal and three bentonite surface mines listed in Table 8 occur on 14 different rehabilitation response units. Thus, of the 86 rehabilitation response units on surface minable lands in the Northern Great Plains, results of rehabilitation research or applied rehabilitation treatments are available for only about 17 percent of the rehabilitation response units. Fortunately, these mines are

Table 8.--Coal and bentonite surface mines on which surface rehabilitation activities have occurred

Kind of mine	Mine no.	Name of mine	State	County	Rehabilitation response unit
Coal	1	Wyodak Resource Develop. Co.	Wyo.	Campbell	117-6-14
Coal	2	Amax Coal Co. (Belle Ayr)	Wyo.	Campbell	117-6-13
Coal	5	Big Horn Coal	Wyo.	Sheridan	25-6-15
Coal	11	Decker Coal	Mont.	Big Horn	117-6-15
Coal	12	Westmoreland (Sarpy Creek)	Mont.	Big Horn	31-4-14
Coal	13	Peabody Coal	Mont.	Rosebud	31-12-16
Coal	14	Western Energy (Colstrip)	Mont.	Rosebud	31-12-16
Coal	15	Knife River (Savage)	Mont.	Richland	26-5-13
Coal	20	Baukol Noonan	N.Dak.	Oliver	35-5-16
Coal	21	No. American	N.Dak.	Mercer	35-5-16
Coal	22	Knife River (Beulah)	N.Dak.	Mercer	23-5-16
Coal	23	Consolidation Coal (Glenharold)	N.Dak.	Mercer	35-5-16
Coal	24	Baukol Noonan (Noonan Strip)	N.Dak.	Burke	19-9-15
Coal	25	Consolidation Coal (Velva)	N.Dak.	McHenry	19-9-16
Coal	26	Knife River Coal (Gascoyne)	N.Dak.	Adams	25-5-15
Bentonite	29	International Minerals & Chem.	Mont.	Carter	111-5-14
Bentonite	30	American Barroid	Mont.	Carter	111-5-14
Bentonite	31	Federal Minerals	Mont.	Carter	111-5-14

distributed over a sufficiently varied range of rehabilitation response units to allow some interpolation of rehabilitation results to other rehabilitation response units.

A brief description of rehabilitation efforts and results on the 18 surface mines listed in Table 8 follows.

1. Wyodak Resources Development Co. The top 10 feet of overburden is sandy with no adverse chemical characteristics. Spoil banks have been graded to a level or gently sloping configuration. An action program was instituted to revegetate the completed areas of spoil banks. Areas were lightly disked and seeded in the spring of 1972 to crested wheatgrass, green needlegrass western wheatgrass, and four-wing saltbush. No supplemental irrigation was applied. Excellent stands were obtained by planting on spoils from both shallow and deep depths. However, the vigor of stands grown on spoil banks derived from shallow depths was better. Short-term conclusions about this mine are that the overburden from deep depths is not toxic, that spoil banks finished off with material from near the surface provides better growth, that rehabilitation can be accomplished here without irrigation, and that very good rehabilitation success can be achieved on rehabilitation response unit 117-6-14.

2. Amax Coal Company (Belle Ayr). This mine is on the Wyodak seam in northeastern Wyoming. The overburden consists of mixed sandstone, claystone, and shale; and is quite sandy. No toxic

or sterile overburden has been identified. As at the Wyodak mine, the upper 10 feet of overburden has been found to be best for final surface implacement on graded spoils. Spoils have been shaped to a gentle slope similar to the natural topography. There are no serious erosion problems. Both the University of Wyoming and the Rocky Mountain Forest and Range Experiment Station have experimental rehabilitation plantings on this site. AMAX and the Soil Conservation Service have initiated small scale action rehabilitation programs. In the fall of 1972, AMAX, in cooperation with the Soil Conservation Service drilled winter wheat and alfalfa into several acres of overburden and fertilized it with 40-60-30 lbs. per acre of N-P-K, respectively. In the spring of 1973, the Soil Conservation Service planted 30 acres of graded overburden to a mixture of Rosana wheatgrass, green needlegrass, and four-wing saltbush, utilizing a grassland drill. Seed implacement was carefully controlled at a one-half-inch depth. No mulch, special soil amendment, or irrigation was applied on either of these two plantings. Also in the spring of 1973, the Rocky Mountain Forest and Range Experiment Station installed an experimental planting of seven shrub and tree species (225 of each) on newly implaced spoils. None of these was fertilized or watered. Winter wheat and alfalfa germinated and grew well until August 1973, when the entire planting failed because of drought and

the crop was turned under. The grasses and four-wing saltbush became firmly established, and had high survival and vigor at the end of the 1973 growing season. Survival of shrub and tree species at the end of the first growing season were: green ash, 99%, Russian olive, 84%, Rocky Mt. juniper, 52%, silver buffaloberry, 44%, ponderosa pine, 41%, American plum, 31%, and Siberian tea shrub, 17%.

Short-term conclusions that can be drawn from rehabilitation effort on this mine, representative of rehabilitation response unit 117-6-13, are: (1) grading of spoils to gentle slope reduces or eliminates erosion of the soil surface; (2) fertilizer improved initial growth while the ground was still moist. It apparently does not enhance survival after the ground dries out; (3) native grasses and shrubs--as well as adapted, introduced ones--establish and survive very well where the top 10 feet of overburden has been used to finish off the spoil surface; and (4) in years of average and above precipitation, initial establishment of adaptable plant species should not be difficult on this rehabilitation response unit.

5. Big Horn Mine. This mine is located near Sheridan, Wyoming in rehabilitation response unit 25-6-15. Overburden from the mine has been graded from level to grades of 2½ to 1. The top several feet of overburden are moderately fertile and stable. No severe surface erosion is evident. Rehabilitation work on this mine has been in progress since 1967. Native grama grasses,

needlegrasses, and wheatgrasses, as well as introduced crested and slender wheatgrasses, were planted. Both native and introduced trees and shrubs were also planted. Rye has been used with extreme success as a nurse crop for new grasses. When planted in the spring, it sprouts in from 1 to 3 weeks, covering most of the soil and protecting it against erosion during the first year. The Plachek plot, the first one planted in 1967, supports a very good stand of perennial grasses after 6 years. All other areas planted subsequently also support good stands of perennial grasses. Application of phosphorus and nitrogen fertilizer to newly regraded spoils, finished off with topsoil, provides an excellent boost to new plant growth from this mine, as long as the soil is moist. Several tree species grow well in the area if irrigation water is available at the time of planting. Repeated watering of newly planted trees during the first growing season enables them to establish an adequate root system. Failure to water substantially reduces the survival rate.

This mine encroaches upon the Tongue River, where it has cut through a series of steep hills. Part of the area has been reshaped to create a lake which the Tongue River flows into and out of. This reclamation and rehabilitation has been coordinated between Peter Kiewitz Construction Company, owners of the mine, and the State Parks Department of Wyoming. When mining is

completed, a state park will be ready, or nearly ready, for use. Conclusions from 6 years of rehabilitation efforts at this mine are: (1) rye as a nurse crop provides quick protection against surface soil erosion and enhances establishment of perennial vegetation; (2) good stands of perennial grasses and a variety of trees and shrubs can usually be established on this rehabilitation response unit; (3) grasses do not require supplemental irrigation for establishment, but trees and shrubs survive much better with periodic watering during the first year. Fertilizing--especially with phosphorus and nitrogen-- improves the rate of plant growth while the soil is still moist.

11. Decker Coal Company. This mine is located at Decker, Montana in rehabilitation response unit 117-6-15. The soils at the Decker mine contain excess soluble salts and exchangeable sodium. Surface evaporation has drawn sodium salts to the surface. Most vegetation in the area, including blue grama grass, needlegrass, and western wheatgrass, are drought and saline-alkaline tolerant species.

Surface soil was removed and stockpiled separately from the main overburden piles. After mining, the overburden piles were regraded to a level or gently sloping grade not exceeding 5 to 1, and finished off with topsoil. After mining, the configuration of the landscape is similar to that before mining. In most places, conventional farm machinery can be used for mine rehabilitation activities.

Rehabilitation research at the Decker mine was begun in 1971 by the Montana Agricultural Experiment Station. Initially, the major emphasis was placed on overburden analysis to evaluate the seriousness of the saline-alkaline problem. More than 70 plant species were seeded. In the fall of 1973, the Intermountain Forest and Range Experiment Station established a completely randomized block experiment on Decker mine spoils to test the effects of irrigation versus no irrigation, fertilizer versus no fertilizer, and mulch and no mulch on three mixtures of all native, native and pasture, and all pasture grasses. No evaluation of the Montana Agricultural Experiment Station plants is available. First-year results of the Intermountain Station's plantings indicate that the best native species are slender and western wheatgrasses and green needlegrass. The best responding introduced species are smooth brome, winter rye, and tall wheatgrass. Gypsum appears to effectively mitigate the adverse effects of saline-alkaline soils on these plants. Mulching enhances early germination and survival by conserving soil moisture. Phosphorus-nitrogen fertilizer and irrigation each separately increased vegetative growth and production. Fertilizer and irrigation, together, produced even greater increases in production. Topsoiling, alone, produced fair stands of vegetation, but not as good as those developed with gypsum as a soil amendment, fertilizer, and irrigation. At the end of the first growing season, European sage had survived and grown well, and was the best of the planted shrubs.

Short-term results from rehabilitation research efforts on this mine are: (1) vegetation can be reestablished on rehabilitation response unit 117-6-15. Results are likely to be fair to poor in the absence of mulching to conserve soil moisture, phosphorus and nitrogen to stimulate growth, and irrigation and gypsum to counteract the adverse physiological effects of large amounts of sodium; (2) introduced grass species produce the greatest volume during the first year, but the native species produce surprisingly more than had been expected so soon; and (3) research for a longer period of time is needed on the Decker mine before the stability and permanency of planted vegetation can be evaluated.

12. Westmoreland Resources (Sarpy Creek). This mine is a new one near Hardin, Montana, in rehabilitation response unit 31-4-14. The area is gently sloping, with soils varying from medium to moderately coarse texture. Adequate topsoil is available to be stockpiled and used to cover spoil surfaces during rehabilitation. Native vegetation is typically of vegetation type 4, consisting of green needlegrass, western and blue bunch wheatgrasses, sideoats grama, needle-and-thread, Idaho fescue, skunkbush sumac, chokecherry, hawthorne, snowberry, and, on some areas, ponderosa pine.

Overburden analyses show no significant differences between raw spoil materials and surface material with respect to either sodium or salinity hazard. Initial plantings in the fall of

1973 have not yet had time to germinate and develop. While there appears to be no problem in soil toxicity, vegetative suitability, or precipitation characteristics that would prevent establishment of plant cover on this mine, the limiting factor is likely to be the rather mediocre natural productivity of this soil.

13&14. Peabody Coal Company and Western Energy Company Mines. (Colstrip). These two mines are located at Colstrip, Montana, in rehabilitation response unit 31-12-16. The soil varies from moderately fine to coarse texture. Vegetation typifies the mid-shortgrass prairie, but with scattered stands of ponderosa pine occurring. Surface soil materials are available on both these mines in ample quantities to cover less desirable overburden materials.

Both Peabody and the Western Energy Company have cooperated extensively in the research program with Montana Agricultural Experiment Station. Many species of grasses, shrubs, and trees have been screened in utilizing different site preparation methods. Two seams of coal are being mined at the Peabody site. During early rehabilitation attempts, a toxic blue-gray shale between the seams ended up on the surface, creating difficulties in establishing vegetation. Mining techniques have since been changed to correct this situation. Rehabilitation research has been underway longer at Colstrip than at any

other sites in Montana. The short-term (3 year) results indicate that successful rehabilitation of rehabilitation response unit 31-12-16 with a variety of grasses, shrubs, and trees is highly probable. The most limiting major factor is the inherent mediocre productivity of soil association 31.

15. Knife River Coal Company (Savage). This mine is located on rehabilitation response unit 26-5-13. Topography is gently sloping with shallow to deep, well drained soils. Texture of the soil is loam to sandy loam. Topsoil materials range up to 2 feet thick, and are adequate--if stockpiled--for finishing graded spoils during reclamation. Similarly, the sandy yellowish-brown silt loam and fine sandy loam material of the overburden beneath the topsoil have proved very satisfactory for finishing graded spoil surfaces. The gray-colored clay or silty clay above and between the coal seams is toxic and should be buried during the mining operation. Native vegetation is mid-grass prairie, mostly western and slender wheatgrasses, green needlegrass, and prairie sand reed.

Several years ago the Company began grading old spoils to a gentle grade. It has cooperated with the Montana Agricultural Experiment Station and the Soil Conservation Service in several experimental plantings. Excellent stands of both introduced and native grasses have been obtained. Several species of trees have been established successfully. This

success was obtained on spoils which were leveled to a 3-to-1 and flatter slopes, using standard seeding and planting techniques and commonly available plant material. Much of this success can be attributed to the very good productivity and stability characteristics of soil association 26, as well as to the rich and vigorous flora of the mid-grass prairie.

20. Baukal-Noonan (Center). This mine is a few miles southeast of Center, North Dakota on rehabilitation response unit 35-5-16. Terrain is rolling and the soil is loamy. The overburden is sandy and shaley. Spoils on this mine have been unusually well shaped and blended into the natural landscape.

Research has shown that the overburden on lignite coal deposits that characterize most of North Dakota contains substantially higher quantities of sodium than does overburden on the subbituminous coal deposits farther west in eastern Montana and northeastern Wyoming. This difference has given rise to more serious sodium toxicity problems in connection with rehabilitation effort on surface mines in North Dakota than has been experienced on most mines in Montana or Wyoming. Sodium content of overburden from Baukal-Noonan's (Center), North Dakota mine, while somewhat higher than that encountered on the Montana and Wyoming mines, is still substantially less than that on any of the other major North Dakota mines. Accordingly, overburden on this mine forms a relatively favorable planting

medium, limited only by the rather mediocre inherent productivity of soil association 35. A variety of cool-season grasses and legumes have been planted on this mine, including western wheatgrass, big and little blue stem, sweet clover, and crown vetch. Success of the various plantings is generally good, including those areas drilled in the fall of 1972. This soil association has very poor stability characteristics, and deep rilling has occurred where spoil slopes were left too steep for cross-slope finish work. Where spoils have been drilled up and down slope, a high erosion hazard exists. Level or gentle slopes and cross-slope cultivation appear to be essential for permanently stable reclamation of this rehabilitation response unit.

21. North American Coal Company (Zap, North Dakota). This mine, located near Zap, North Dakota, is situated on rehabilitation response unit 35-5-16. Overburden resulting from mining here has been shown to have the second highest average sodium content of eight major mines sampled in North Dakota. Spoils from this mine have the highest sodium absorption ratio and pH of any mine for which records are available in the Northern Great Plains. The fine textured spoil materials consist largely of montmorillonitic clay, are very low in natural organic matter, and are highly toxic to vegetation.

Overburden from this mine--except that within approximately 10 feet of the original surface--presents a tremendous rehabilitation problem if placed on the surface of graded spoils.

Analyses of North Dakota overburden by depth increments indicate that the sodic nature of the spoils increases with depth within the feasible depth range for surface mining. Experience on this mine indicates that, over a period of several years, adsorbed sodium in the mine spoils can be reduced somewhat with a chemical amendment (gypsum), or it can be circumvented by applying a surface layer of soil. Little success has been achieved in rehabilitating raw spoils originating from deep sodic layers. The dispersing effect of sodium renders the spoil material extremely unstable, highly impermeable, and erodible.

Where graded spoils have been finished off with overburden from shallow depths, immediate fertilizing with phosphorus followed within 2 years with nitrogen, together with vegetative mulch disked into the spoil surface, resulted in grass production increases of as much as 1,000 percent compared to the production on raw spoils.

It seems fair to conclude that, on this mine and others having similar adverse spoil characteristics, further research is needed to overcome the toxicity problems before successful and lasting direct rehabilitation of these spoils can be achieved. Where shallow nontoxic overburden or surface soil can be used to finish spoil surfaces, successful rehabilitation to mid-grass prairie, or, in some cases, to cultivated grain crops, can be achieved.

22. Knife River Coal Company (Beulah, North Dakota). This mine is located on rehabilitation response unit 23-5-16. Overburden materials on this mine have essentially the same sodium and pH characteristics as those found in overburden on the North American mine at Zap. Little real success has been experienced in attempts to rehabilitate raw surface spoils originating from deep levels in this mine. On the other hand, attempts to rehabilitate spoils originating within approximately 10 feet of the ground surface or to rehabilitate spoils dressed with surface soil, utilizing both introduced and native grasses and legumes, have been very successful. One of the reasons for this success is due to the inherent good stability and productivity characteristics of soil association 23.

23. Consolidation Coal Company (Glenharold, North Dakota). This mine--near Stanton, North Dakota--is in rehabilitation response unit 35-5-16. The soil, native vegetation, and precipitation characteristics of this mine are similar to the North American mine at Zap. However, the terrain is considerably steeper and more hilly. The soils are loamy but shallower because of the steeper topography. Overburden is dominantly grayish-white, and the surface dries hard after being wet. This indicates a high sodium content, and tests of overburden confirm that the sodium content at this mine--while not as high as in the Knife River mine at Beulah or in the North American mine at

Zap, is still toxically high. Soil association 35 has very poor stability characteristics, and these are reflected on the steeper spoil slopes where rilling and gullying have occurred.

Where overburden from shallow depths or topsoil has been used to finish the surface of graded spoils, good rehabilitation results have been achieved. Starting recently, mined areas are being graded to gentle slopes, disked, and seeded to cool-season grasses. The Consolidated Coal Company has treated a substantial acreage in this manner. The Company and the Soil Conservation Service planted a variety of shrubs and trees, including green ash, American plum, buffaloberry, Russian olive, Siberian pea, ponderosa pine, and Rocky Mountain juniper. After several years, a good percentage of these plantings have survived and are vigorous. Where problems associated with high sodium spoils have been circumvented, vegetation has become so well established that many areas look virtually undisturbed.

24. Baukal-Noonan (Noonan Strip). This mine, located near Larsen, North Dakota, is in rehabilitation response unit 19-9-15. Overburden from deep levels in this mine has the highest sodium content of any sampled in North Dakota. Consequently, it is toxic for rehabilitation purposes when left on the surface of graded spoils. Surface soil from soil association 19, and, more specifically from this mine, has very good stability and good productivity. Rehabilitation experience here is similar to that

already noted on other North Dakota mines; little success on raw spoils from deep levels; better success on spoils from shallow depths; and best success where surface soil has been removed and then replaced to surface the graded spoils.

25. Consolidation Coal Company (Velva, North Dakota). This mine is situated in rehabilitation response unit 19-9-16. Tests on 10 major surface mines in the Northern Great Plains indicate that the average sodium content of overburden from this mine, although substantially greater than in the Montana-Wyoming area, is still only about half of the sodium content encountered on most of the other surface mines in North Dakota. Spoils on this mine have been graded to gentle slopes. The soil is stable and shows little sign of erosion where it has been regraded. Rehabilitation success has not been very good on raw spoils originating from deep overburden. However, rehabilitation efforts on shallow overburden materials or surface soil dressed spoil areas, utilizing wheatgrasses, blue stems, and legumes, have been very successful.

26. Knife River Coal Company (Gascoyne, North Dakota). This surface mine is located on rehabilitation response unit 25-5-15. Surface soils in this rehabilitation response unit and on this mine are productive and stable. The soil is loamy and the terrain is level to gently rolling. Coal is at a relatively shallow depth, requiring removal of only about 16 to 20 feet of overburden.

Accordingly, sodium should not present a serious problem, and, indeed, tests show that the average sodium content of the overburden is less than that from any of the other North Dakota mines tested. The Knife River Company began reclamation work about 2 years ago. Some spoils have been reshaped to undulating topography. Cool-season grasses have been seeded and are establishing successfully.

29. International Minerals and Chemical Company

30. American Barroid Company

31. Federal Minerals Company (Alzada, Montana)

These three bentonite mines are located in rehabilitation response unit 111-5-14. The topography is nearly level to gently sloping. Soils vary in texture from claypan spots to sandy loams. Little weathering or soil development has occurred on the pan spots, and surface materials for reclamation are not available from these sites. Most of the area has medium textured soils supporting a good cover of western wheatgrass, needle-and-thread, prairie sand reed, and other desirable species. Some burr oaks occur on these sites. These sites can provide weathered soil material necessary for reclaiming mined areas. Reclamation activities on these mines include the placement of about 4 inches of surface soil over all disturbed areas. This has been sufficient to support good seeded stands of grasses--mostly western wheatgrass, green needlegrass, and crested wheatgrass. The raw overburden is

usually composed of saline clays, and stands do not become established on these materials unless they are dressed with surface soil. The companies in this area have been cooperating with the Soil Conservation Service Plant Materials program. Several hundred acres have been very successfully rehabilitated.

IV. CONCLUSIONS

This survey and summary of rehabilitation experience and history on the major coal and bentonite surface mines in the Northern Great Plains indicates several rather common reclamation problems. Perhaps the most common is leaving spoil slopes too steep on the more unstable soil associations, particularly where the spoils have high sodium contents, and rilling and gullying start quickly. Such erosion washes seed and fertilizer from areas needing revegetation. It also robs moisture which is needed in the soil if vegetal cover is to become established and persist. Where possible, it appears that grading to slopes that permit rehabilitation work to be done cross slope is much to be preferred. Overburden conditions adverse to plant growth are often overlooked, although in many cases they are probably recognized. The continued existence of spoils that do not support any vegetal cover--even though exposed for a number of years--bears out this contention. Such material should be recognized and buried. Solutions to many conditions that have been called problems in the past can be achieved by common sense practices, together with interest in and knowledge about conditions that determine plant growth. Nevertheless, variation in sites occurs within even a single rehabilitation response unit, despite gross overall similarities in climate, soil, and vegetation. These are the constraints that negate hard and fast rules about rehabilitation potentials. Good rehabilitation will continue to require site specific application of sound principles of plant-soil-water relations. Above all, a respect for the land is needed that will stimulate the persistence necessary to get the rehabilitation job done adequately.

BIBLIOGRAPHY

Glass, G. B.

1972. Midyear review of Wyoming coalfields. Geo. Surv. of Wyo. Annu. Rep., 42 pp.

Kuchler, A. W.

1964. The potential natural vegetation of the conterminous United States. Amer. Geogr. Soc., Spec. Publication 36, 154 pp.

Landis, E. R.

1973. Coal in mineral and water resources of North Dakota. U.S. Senate Comm. on Interior & Insular Affairs, 93rd Congr. 1st Sess., pp. 45-52.

Thornthwaite, C. W.

1931. The climates of North America according to a new classification. Geogr. Rev. 21: 633-655, illus.

Thornthwaite, C. W.

1941. Climate and settlement in the Great Plains. In.: USDA Yearbook of Agr., pp. 177-188.

Discussion Draft
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ECOSYSTEM RELATIONSHIPS

I. INTRODUCTION

The Northern Great Plains is a portion of the vast mid-continental prairie of North America. Bordered on the west by the Rocky Mountains and on the east by the tall-grass prairie, the Northern Great Plains occupies a unique niche in the ecological complexity of the United States. To the casual observer this region is frequently viewed as a monotonous and limitless flatland occupied only by "nameless grasses and sagebrush." Yet, more careful surveillance reveals a heterogeneous physiography anything but monotonous, and a highly intricate and rich biota of enormous diversity. This region has played an important role in our agricultural and economic growth; now, in this era of crisis we look to the northern plains once again for another resource.

The Ecosystem Relationships section of the Surface Resources Work Group is responsible for analyzing the impacts of resource development alternatives in this region on an "ecosystem basis." As such, an ecosystem approach is apparently intended to lend holistic and integrative (e.g., holocoenotic) analyses to the assessment of impacts resulting from the development of resources. Ideally, such analyses establish interrelationships and interdependencies between surface and energy resources.

Severe time constraints and a shortage of facilities and personnel have limited this analysis rather severely. For an ecosystem approach to be truly complete or holistic, it should include the interrelationships of society and agriculture with the natural biota and environment,

Very little is known about the interconnections of the components of civilization with those of natural systems, and yet we all recognize the need for a total ecosystem framework. Similarly, large knowledge gaps exist in ecosystem research concerning component interrelationships and synthesis of natural systems. Ecologists have done a rather good job of synthesizing concepts of natural ecosystem functions, but basic on-the-ground data are lacking in many areas. The IBP Grassland Biome is an excellent example of a scientific approach to ecosystem analysis, but after years of effort, vitally important studies still need to be done before the complete analysis is perfected. Thus, it is only reasonable to point out that an analysis of the ecosystem relationships of the Northern Great Plains, prepared within the scope of several months and drawing only on existing knowledge, does not by any means represent the "final word" on the subject.

This report delineates, describes, and characterizes the major ecosystems of the Northern Great Plains within limitations. The major components of each ecosystem (e.g., vegetation, animals, soil, physiography, etc.) have been identified and the primary interrelationships among them are discussed. Unfortunately, too much vital basic information is lacking to make a complete analysis of the total behavior and responses of ecosystems to resource development alternatives. Also, knowledge of ecosystem sensitivity to disturbance and potential for recovery is sketchy at best, and is discussed within the framework of existing data. Some rare and endangered plant and animal species are known, and these have been identified.

II. PROCEDURES

The ecosystem concept was first introduced by Tansley (1935), in which he defined the "ecosystem" as a system resulting from the integration of all the biotic and abiotic factors of the environment. Thus, an ecosystem is a functional unit with a complex level of organization, and is very similar if not synonymous with the "biogeocoenosis" of Sukachev (1960). As viewed in this report, an ecosystem is an organization of biotic and abiotic components whose functions include transformations, circulation, and accumulation of matter and energy flow through living organisms and physical processes. The nature of the interacting components of an ecosystem are shown in Figure 1.

The complex level of organization in an ecosystem, in increasing order of complexity, is illustrated by Van Dyne (1966, 1969a, 1969b) as: cell < tissue < organ < organism < population < community < ecosystem. Rowe (1961), and later Küchler (1973), illustrated the components of the ecosystem as shown in Figure 2. In an effort to avoid semantic arguments, and in order to follow generally accepted techniques and theory, the ecosystem models proposed by Van Dyne (1969a, 1969b), Rowe (1961), and Küchler (1973) were followed in the preparation of this report.

One of the most difficult problems, once a theoretical model has been accepted, is to apply theoretical concepts to actual conditions. If we can accept Tansley's (1935) interpretation that size and extent of ecosystems will be determined according to the purposes and methods

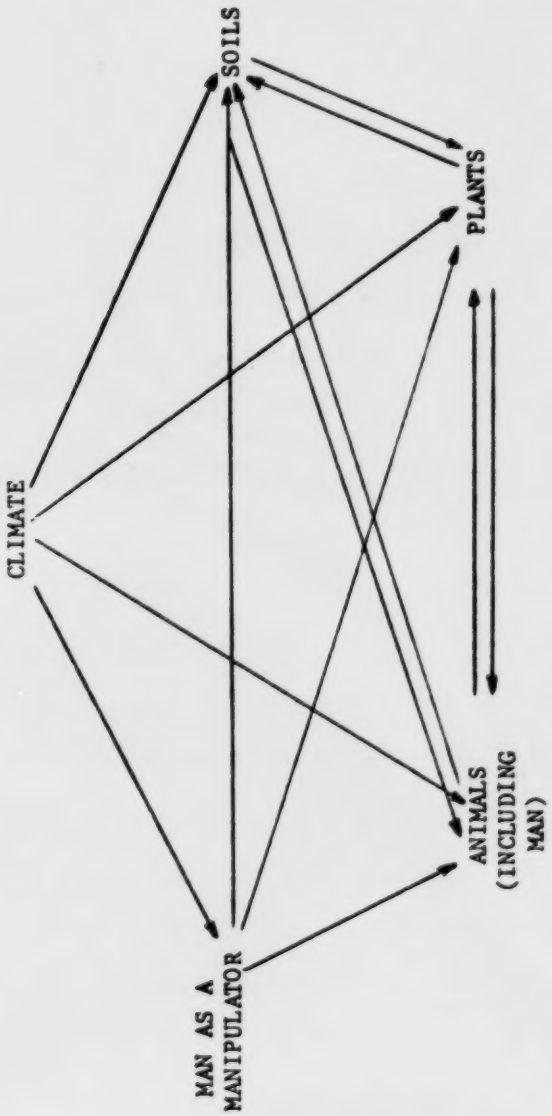

Fig. 1. An ecosystem is an integrated complex of living and nonliving components. Each component is influenced by the others, with the possible exception of macroclimate. And now man is on the verge of exerting meaningful influence over macroclimate.

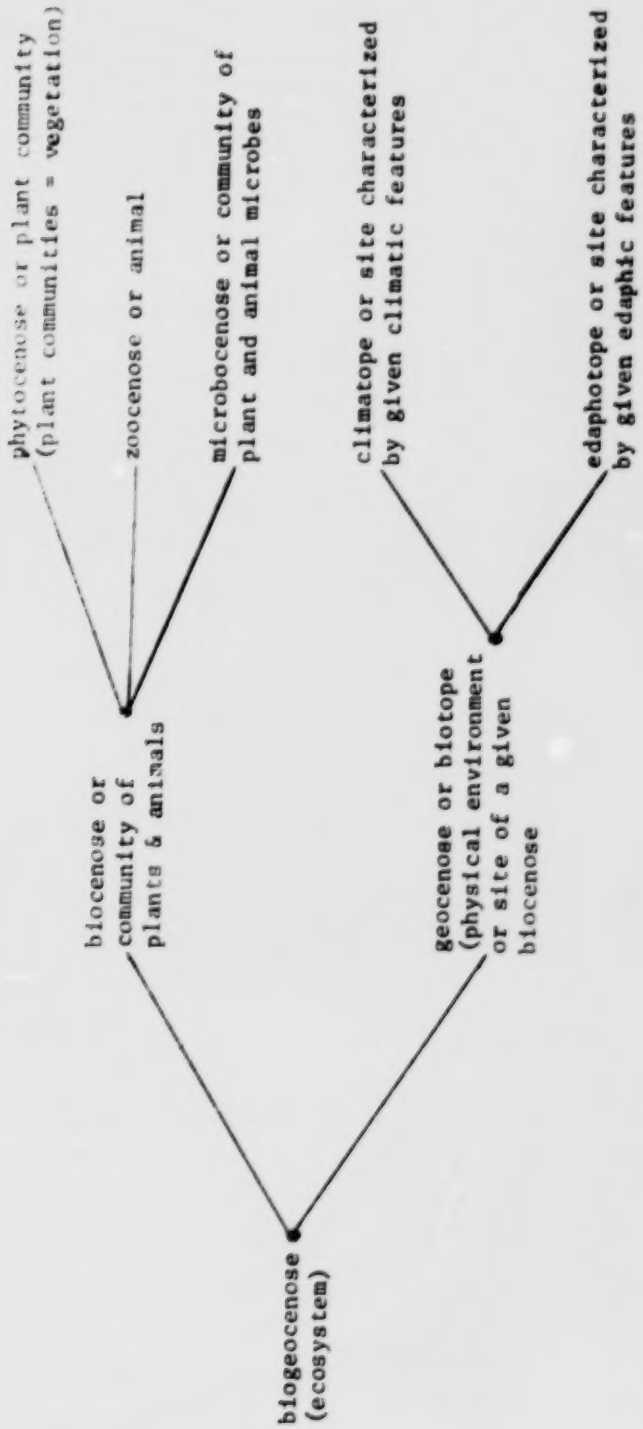

Fig. 2. The position of vegetation within the ecosystem (after Rowe 1961, elaborated).

of particular studies, then we have accomplished the first step. In one step further, we can apply the reasoning of Rowe (1961) that ecosystems, to be fundamental units of study, must be recognizable entities whose components are equally recognizable and have common bonds linking them inclusively.

The greatest difficulty in this effort involved selection of criteria upon which to delineate ecosystems. For the Northern Great Plains it appeared that four basic ecosystem components would provide the most reliable indicators (Van Dyne 1969a). These include:

1. Vegetation (or phytocoenoses)
2. Fauna (or zoocoenoses)
3. Soils
4. Physiography.

Climate is also an important ecosystem component, probably affecting ecosystem distribution more than any other factor other than man (Row 1961, Küchler 1973). However, the other ecosystem components such as vegetation and soils are integrators of climate and reflect through their characteristics the general nature of the prevailing climate.

Because of time constraints the decision was made to delineate only natural ecosystems, and to characterize them in terms of native vegetation distribution. This is believed to be the most logical approach since vegetation reflects the influence of climate, soils, physiography, and animal impacts to a more sensitive degree than other ecosystem components. This decision further facilitated the use of existing data to help in delineating ecosystems. In this sense,

liberal use was made of a wide array of such existing maps and data on the ecosystems of the Northern Great Plains as the Küchler map (1964), the Aandahl soil map (1972), the Agricultural Research Service Plant Hardiness Zone Map (1965), and various vegetation maps provided by State universities. Numerous other sources of information were also used; they are quoted in the various ecosystem descriptions below.

An attempt was made to delineate as ecosystems those vegetation types that display uniform species dominance and structure existing on similar soil associations. The influence of animals, both vertebrate and invertebrate, was considered where data permitted. This approach was used to prepare a composite map of the ecosystems of the Northern Great Plains, Appendix E, Plate 9.

The boundaries of the ecosystems shown on the map imply definite breaks in biotic and abiotic interrelationships. In some instances, as the boundary between some forest types and grasslands, a sharp transition occurs, which implies an obvious ecosystem boundary. In others, however, such as between different grassland types, boundary location becomes somewhat problematical and ill-defined. It is quite possible that a population cline or continuum exists on the grasslands in some areas, in which distinct boundaries do not exist. However, for mapping, an interpretation must be made based on the best evidence available; the map in Appendix E reflects this effort. The boundaries on the map in Appendix E do not always coincide exactly with those of Küchler (1964) or Morris (1964). Occasionally, judgments were made

to reconcile differences in boundary placement by various authors, and boundaries were drawn based on on-the-ground experience of the subgroup members. In any event, it must be recognized that exact boundaries between ecosystems are subjective at best simply because they either do not exist as such, or they fluctuate with time as climatic conditions dictate.

Plate 9, Appendix E does not illustrate all of the ecosystems on the Northern Great Plains. There are definite ecosystems in this region which geographically occupy far too small an area to be displayed at a scale of 1:1,000,000. For instance, the important Badlands ecosystem, although of wide and common occurrence, is illustrated only in areas where it occupies large geographical areas. Also, one must recognize that ecosystems do not usually occupy large geographical areas as pure types to the exclusion of all others. In many instances, isolated pockets of one ecosystem occupy sites within another ecosystem. In fact, the actual situation on the ground is, at best, rather poorly represented by a map.

It should also be noted that vegetation types, as representatives of ecosystems based on physiognomy, often do not coincide with the soil association boundaries. This is not surprising because soil types are mapped according to different criteria than are vegetation types. Also, it may be noted that vegetation type boundaries will not coincide exactly with either the ecosystem boundaries or soil association boundaries. Unless the criteria used to distinguish soils and vegetation types are the same as those to which ecosystems react, then discrepancies occur.

III. RESULTS

Sixteen major ecosystems have been delineated and characterized on the Northern Great Plains (Table 1). Careful study in the future may reveal additional ecosystems that should be distinguished.

These 16 ecosystems were distinguished on the basis of existing data only; no ground verification was possible.

Table 1 lists the 16 ecosystems on the Northern Great Plains, together with a brief description of their characteristics, and a list of the corresponding Küchler types. A narrative description of each ecosystem follows and includes descriptions of: topography, soils, vegetation, fauna, and ecosystem interactions and limitations. Following these descriptions, endangered plant and animal species are listed. These have not been specified for each ecosystem alone because data are unavailable for the most part.

Such a broad regional profile as this, prepared in a short time-frame, precludes including many desirable analyses. Therefore, only brief mention is made of the major species characterizing each ecosystem. Soils and topography data are presented in greater detail in the Soils subgroup report. Plant and animal species lists and distributions are discussed in greater detail in the Vegetation and in the Fish and Wildlife reports, respectively. The major contribution of this Ecosystem Relationships report is to provide an integrated analysis of the interrelationships and limitations of major components of each ecosystem.

Table 1. Characteristics of ecosystems in the Northern Great Plains, and corresponding Küchler types

Ecosystem	Characteristics	Similar Küchler type
1. Floodplain	a. Major river bottoms and banks; hardwood tree species; alluvial soils b. Broad floodplain terraces; alluvial soils, highly saline; high water table; greasewood.	98
2. Badlands	Breaks along rivers and streams, buttes and south slopes associated with ponderosa pine forests; exposed clay and sandstone shale.	--
3. Short-grass prairie	Dry prairie in SE Montana and NE Wyoming; blue grama, western wheatgrass, needlegrasses; shallow soils	64
4. Mid-short grass prairie	Rolling prairie in eastern Montana; western wheatgrass. needle-and-thread, blue grama; loam to clay loam soils	64,66
5. Mid-grass prairie	No short grass dominants, eastern Montana, North and South Dakota; needlegrasses, wheatgrasses, bluestems; loamy soils	66
6. Grassland-sagebrush	Open grassland of mid and short grasses, with scattered sagebrush; SE Montana, NE Wyoming; silty clay loams	56
7. Sagebrush-steppe	Sagebrush dominant with open grassland of wheatgrasses, needle-and-thread; silt to silty clay loams	55

(con. next page)

Table 1 (con.)

Ecosystem	Characteristics	Similar Küchler type
8. Grassland-sandsage	Restricted NE Wyoming on sandy soils; hummocky sand dunes; bluestems, grama, sandreed, sandsage	70
9. Mid-tall grass prairie	Gently rolling prairie, North Dakota; loam soils of glacial till; wheatgrasses, big bluestem, little bluestem, needlegrasses	67
10. Foothills grassland	Rolling foothills adjacent to forest, eastern Montana, NE Wyoming loam soils; wheatgrasses, fescue, needlegrasses, forbs	50
11. Prairie-oak savanna	North Dakota tall grass prairie on glacial till loams; hummocky; bluestems, sandreed, needlegrasses, wheatgrasses, bur oak	81
12. Ponderosa pine forest	Uplands, ridges, breaks, north slopes, shallow stony loam soils; ponderosa pine, snowberry, bluegrass, fescue, junegrass	16
13. Black Hills pine forest	Black Hills of South Dakota, NE Wyoming; limestone and calcareous sandstone; ponderosa pine, spruce, aspen, oak, ash	17
14. Douglas-fir forest	Big Horn and Big Snowy Mountains; deep soils, high organic matter; Douglas-fir, snowberry, ninebark, forbs, grasses	12

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Table 1 (con.)

Ecosystem	Characteristics	Similar Küchler type
15. Ponderosa pine--Douglas-fir forest	Laramie Mountains, similar to Douglas-fir forest, but drier; stony soils	18
16. Subalpine	Big Snowy Mountains, high elevation, shallow stony soils; lodgepole pine, whitebark pine, forbs, sedges, grasses	8

1. Floodplain Ecosystem

The floodplain ecosystem occurs along perennial and some intermittent streams and rivers, and is characterized by trees or shrubs and grasses that obtain water directly from the water table. This ecosystem consists of two different types: (1) the cottonwood-hardwood tree type occurs primarily along the larger river bottoms, and (2) the greasewood-grass type along the broad flat terraces and floodplains of the major rivers.

Topography:

This ecosystem occurs on flat to gently sloping river bottoms, on level floodplains, and on low benches or terraces on bottom lands adjacent and parallel to the streams.

Soils:

Soils are usually deep and have developed from recent sandy and loamy alluvium. These alluvium deposits have variable textures, salt and lime contents, and drainage. In areas of high salt content the greasewood-grass type predominates. (See the Soils subgroup report for details on alluvium soils.)

Vegetation:

The most obvious vegetation of this ecosystem is composed of cottonwood trees. Often the larger streams and rivers can be seen from miles away because of the large trees lining their banks. On broad terraces that have highly saline conditions, greasewood is the dominant plant species. Greasewood is among the more saline

tolerant species in the Great Plains, but is not solely restricted to high salt concentration areas. This species also achieves codominance status in some badland plant communities.

Characteristic Plant Species

Populus deltoides	cottonwood
Salix missouriensis	Missouri willow
Salix interior	sandbar willow
Rosa woodsii	woods rose
Fraxinus lanceolata	green ash
Acer negundo	box elder
Sarcobatus vermiculatus	greasewood
Distichlis stricta	salt grass
Poa arida	plains bluegrass
Agropyron smithii	western wheatgrass

Fauna:

This ecosystem provides cover and water for wildlife, and is vitally important throughout the year for these purposes.

Characteristic Animal Species

Castor canadensis	beaver
Odocoileus virginianus	white-tailed deer
Odocoileus hemionus	mule deer
Procyon lator hirtus	raccoon
Buteo jamaicensis	red-tailed hawk
Mustela vison letifera	mink

Characteristic Animal Species (con.)

Pica pica	magpie
Thannophis radix	garter snake
Mustela longicauda	long-tailed weasel
Spilogale putorius interrupta	spotted skunk
Mephitis hudsonica	striped skunk
Vulpes regalis	red fox
Canis latrans	coyote

Ecosystem Interactions and Limitations:

The scarcity of live streams on the Northern Great Plains makes each existing stream all the more important to the natural order of ecosystem dynamics. Particularly from the standpoint of animal populations and migration routes, this ecosystem plays a vital role. The vegetation is especially important in erosion control during periods of high runoff. Water quality is important for domestic purposes. This ecosystem is associated with nearly every other ecosystem on the Northern Great Plains and is affected by them primarily as a result of runoff and erosion conditions, and by wildlife use. In addition to the role played by vegetation in stabilizing riverbanks and in providing animal cover, it is also important for maintaining water quality for fish and aquatic organisms. This ecosystem is very sensitive to disturbance.

2. Badlands Ecosystem

The Badlands ecosystem occurs widely in all four States of the study area. It occurs along river and stream breaks as well as throughout the grasslands as isolated buttes and slopes. Badlands along the Little Missouri River are particularly numerous, forming a belt 5 to 25 miles wide and more than 200 miles long. Major expanses of badland topography are along the upper reaches of the Powder River and its confluence with the Yellowstone River. This ecosystem occupies the breaks and extensive areas around the Fort Peck Reservoir. Badlands topography is common on south slopes of breaks along the upper portions of the Powder and Tongue Rivers in southeastern Montana and northeastern Wyoming (not illustrated on map in Appendix E).

Topography:

Badlands topography consists of outcrops of parallel beds of clay and silt shales, interspersed with lignite seams of varying thickness, massive outcroppings of sandstone strata, and colluvial talus. Badlands reach their most characteristic development on steep breaks or south slopes, and display multicolored bands of exposed geological materials. This type is highly dissected and complex, and slopes range from about 20 to more than 100 percent.

Soils:

The Badlands are, for the most part, composed of undeveloped geological material and do not support soils in the strictest sense

of the definition. However, Aandahl soil association #184 (Soils subgroup report) provides an approximate description (Brown 1965, 1971).

Vegetation:

Although the average annual precipitation in badlands areas is about 10 to 14 inches, the Badlands are probably the driest ecosystem in the Northern Great Plains because of the severe microclimatic conditions on steep south slopes. Some badlands slopes, as a consequence, appear to be completely devoid of vegetation. In fact, however, they support a highly complex vegetation composed of grasses, forbs, shrubs, and trees.

Characteristic Plant Species

Atriplex confertifolia	shadscale
Artemisia tridentata	big sagebrush
Chrysothamnus nauseosus	rubber rabbitbrush
Sarcobatus vermiculatus	greasewood
Suaeda fruticosa	suaeda
Gutierrezia sarothrae	broom snakeweed
Artemisia frigida	fringed sagebrush
Rhus trilobata	skunkbush sumac
Agropyron smithii	western wheatgrass
Agropyron spicatum	bluebunch wheatgrass
Aristida longiseta	three-awn
Bouteloua gracilis	blue grama
Distichilis stricta	salt grass

Characteristic Plant Species (con.)

Oryzopsis hymenoides	Indian ricegrass
Sporobolus cryptandrus	sand dropseed
Achillea millefolium	yarrow
Salsola kali	Russian thistle
Juniperus scopulorum	Rocky Mountain juniper

Fauna:

The Badlands provide a highly complex and unique wildlife habitat for many animals. Rims, breaks, buttes, and massive outcrops, coupled with variety in color, exposure, and forage, make the Badlands an important wildlife area.

Characteristic Animal Species

Odocoileus hemionus	mule deer
Aquila chrysaetos	golden eagle
Buteo jamacieusis	red-tailed hawk
Falco mexicanus	prairie falcon
Crotalis viridis	prairie rattlesnake
Phyrnosoma douglassi	short-horned lizard
Lepus townsendii	jack rabbit
Sylvilagus auduboni	Wyoming cottontail
Vulpes regalis	red fox
Canis latraus	northern coyote
Taxidea taxus	badger
Mephitis hudsonica	skunk
Citellus tridecemlineatus	ground squirrel

Characteristic Animal Species (con.)

Cynomys ludovicianus	prairie dog
Mustela longicauda	weasel
Peromyscus maniculatus	white-footed mouse

Ecosystem Interactions and Limitations:

The Badlands of the Northern Great Plains are commonly thought of as waste areas offering no conceivable value to man and his economy. Unfortunately, this misconception is fostered by the unbecoming name given these areas. In reality, however, the Badlands ecosystem, although being the driest in the study area, is perhaps the most complex. At least seven different and highly distinct plant communities occur in the Badlands (Brown 1971), each expressing a very close sensitivity to environmental variations. The Badlands ecosystem is, in many respects, an edaphic-physiographic complex supporting, at least in part, a northern extension of the salt desert into the prairie region of the Great Plains. Ecologically, these plant communities are extremely sensitive to disturbance, and reclaiming them to subclimax status would require many decades under natural succession. The Badlands are high erosion areas with low infiltration and low soil fertility, and are in a constant state of flux. From quite another viewpoint, the Badlands are highly scenic areas with obvious potential recreational values. Multicolored slopes of exposed strata interspersed by veins of black lignite coal, together with the resulting effect on vegetation distribution, provide a display of hues and colors that is truly striking.

3. Short-Grass Prairie Ecosystem

This ecosystem is composed typically of short- and mid-grass species common to the Northern Great Plains, occurring in open to rather dense stands. It occurs in eastern Montana and northeastern Wyoming, primarily on gently rolling prairie, and represents the driest grassland ecosystem in the region.

Topography:

This ecosystem is found on undulating and rolling slopes, and on lower slopes of hilly topography on south slopes. Slopes range mostly from flat to about 30 percent on well defined deep drainage patterns.

Soils:

The soils of this ecosystem have mainly developed from clayey shales or silty shales, with mean annual precipitation ranging from 10 to 14 inches. Soils are subject to wind and water erosion, and are typically droughty during the growing season.

Vegetation:

Vegetation of this ecosystem has been broadly referred to as "short-grass prairie" (Weaver and Clements 1938), although it is composed of many mid-grasses, forbs, and shrubs as well. The key indicator of this ecosystem is the abundance of blue grama (*Bouteloua gracilis*) as a dominant, although dominance is often shared with western wheatgrass (*Agropyron smithii*) on clayey soils.

Characteristic Plant Species

Bouteloua gracilis	blue grama
Agropyron smithii	western wheatgrass
Stipa comata	needle-and-thread
Agropyron dasystachyum	thickspike wheatgrass
Koeleria cristata	prairie junegrass
Stipa viridula	green needlegrass
Aristida longiseta	three-awn
Sporobolus cryptandrus	sand dropseed
Carex filifolia	threadleaf sedge
Carex eleocharis	needleleaf sedge
Achillea millefolium	western yarrow
Psoralea argophylla	silver leaf
Artemisia frigida	fringed sagebrush
Artemisia tridentata	big sagebrush
Rhus trilobata	skunkbush sumac

Fauna:

At one time, bison was the dominant herbivore in this ecosystem, and played a significant roll in affecting its plant species composition. Presently, the antelope is the only abundant native herbivore remaining in this area. Deer are commonly found primarily adjacent to forest areas and along badland and river break areas (see Fish and Wildlife subgroup report).

Characteristic Animal Species

Antilocarpa americana	antelope
Lepus townsendii	whitetailed jackrabbit

Characteristic Animal Species (con.)

Cynomys ludovicianus	blacktailed prairie dog
Citellus tridecemlineatus	pale striped ground squirrel
Microtus pennsylvanicus	badland meadow mouse
Speotyto cunicularia	burrowing owl
Circus hudsonius	marsh hawk
Sturnella neglecta	western meadow lark
Eremophila alpestris	horned lark
Ammodramus bairdii	Baird's sparrow
Taxidea taxus	common badger
Canis latrans	northern coyote
Vulpes regalis	northern red fox
Mustela nigripes	black-footed ferret
Thomomys talpoides	pocket gopher

A large population of rodents inhabits this ecosystem and provides prey for various predators such as badgers, coyotes, foxes, hawks, and owls.

Ecosystem Interactions and Limitations:

This ecosystem is the most xeric of the grassland ecosystems, and one of the driest in the Northern Great Plains. Disturbances herein have severe consequences because of the extremely slow rate of recovery through natural plant succession. Grazing pressure plays an important role in maintaining the short-grass dominance in this ecosystem, and during periods of drought the short-grass physiognomy predominates, particularly on south exposures (Weaver and Albertson 1956).

This ecosystem is very sensitive to disturbance and, coupled with such environmental extremes as low water availability and south exposures, natural succession is extremely slow. During periods of extended drought, the boundaries of this ecosystem are quite flexible, moving north and east into the mid-grass prairie ecosystem (Küchler 1973).

It is believed that true short-grass prairie is a disclimax resulting from disturbances such as grazing (Weaver and Albertson 1956). This is not to imply that such short-grasses as blue grama are not part of the natural dominant cover. On the contrary, short-grasses are legitimate climax species that, even under protected conditions, are dominants. On drier sites, blue grama is the primary dominant from which this ecosystem derives its name; it should figure in surface mine rehabilitation efforts in this area. Whether the short-grass prairie can be described as a disclimax is really not a question here; the fact that short-grass physiognomy dominates the general appearance of this ecosystem, and that this ecosystem has an ecological character quite different from that of surrounding grasslands, is sufficient evidence to delineate it as a discrete entity.

4. Mid-Short Grass Prairie Ecosystem

The mid-short grass prairie ecosystem occupies a large portion of the gently rolling grasslands of eastern Montana. It is distinguished from the short-grass prairie ecosystem primarily on the basis of a shift in dominance from short- to mid-grasses.

Topography:

This ecosystem occurs on rolling and hilly topography with slopes ranging from 0 to 30 percent and on well defined drainage slopes.

Soils:

The soils are derived primarily from clay and silt shales, with a mean annual precipitation ranging from 12 to 16 inches.

Vegetation:

The vegetation has been referred to as "mixed-grass prairie" because of the character imposed by the presence of both mid- and short-grasses (Weaver and Clements 1938; Weaver and Albertson 1956). The primary difference between this ecosystem and the short-grass prairie is the obvious dominance of mid-grasses such as western wheatgrass, needle-and-thread, and green needlegrass. The main short-grass component, blue grama, normally occupies a subdominant, or on drier sites, a codominant position in the vegetative structure of this ecosystem. On clay soils, western wheatgrass achieves dominance, whereas on more mesic silty soils, the needlegrasses are more prominent.

Characteristic Plant Species

Agropyron smithii	western wheatgrass
Stipa comata	needle-and-thread
Stipa viridula	green needlegrass
Bouteloua gracilis	blue grama
Agropyron dasystachyum	thickspike wheatgrass

Characteristic Plant Species (con.)

Koeleria cristata	prairie junegrass
Aristida longiseta	three-awn
Sporobolus crystandrus	sand dropseed
Carex filifolia	threadleaf sedge
Carex eleocharis	needleleaf sedge
Achillea millefolium	yarrow
Yucca glauca	yucca
Artemisia tridentata	big sagebrush
Artemisia cana	silver sagebrush
Artemisia frigida	fringed sagebrush
Rhus trilobata	skunkbush sumac

Fauna:

Antelope is the most abundant native mammal herbivore remaining in this ecosystem. Deer are common in the mesic draws and ravines, and adjacent to forested areas and badlands.

Characteristic Animal Species

Antilocarpa americana	antelope
Lepus townsendii	whitetailed jackrabbit
Odocoileus hemionus	mule deer
Canis latrans	coyote
Cynomys ludovicianus	prairie dog
Speotyto cunicularia	burrowing owl
Circus hudsonius	marsh hawk
Sturnella neglecta	western meadow lark

Characteristic Animal Species (con.)

Taxidea taxus	badger
Vulpes regalis	red fox
Mustela nigripes	black-footed ferret
Thomomys talpoides	pocket gopher

Ecosystem Interactions and Limitations:

This ecosystem is very similar to the short-grass prairie ecosystem, and the two are commonly found side by side. As explained by Küchler (1973), these two ecosystems demonstrate highly elastic boundaries during periods of climatic change or following such disturbances as grazing. During dry years the short-grass ecosystem appears to invade and achieve dominance over the mid-grasses. Following heavy grazing or other disruptive disturbances, similar changes occur. It can be expected that surface mine disturbances may result in more xeric conditions in some locations because of the altered nature of the soil material and exposures. In such instances, local microclimatic changes may act in a compensatory manner so as to introduce short-grass prairie conditions into the mid-short grass ecosystem. Additionally, more mesic conditions may be created, which possibly could provide conditions for mid-grass dominance to the total exclusion of short grasses. In any case, one may expect that short-grass dominance will appear in xeric or disturbed sites, and mid-grass dominance will be achieved on more mesic sites.

5. Mid-Grass Prairie Ecosystem

The mid-grass prairie ecosystem occupies the largest geographical area of the Northern Great Plains, occurring in eastern Montana, western North and South Dakota, and northeastern Wyoming. In some respects, it may resemble the mid-short grass prairie ecosystem.

Topography:

This ecosystem occurs on gently rolling to flat topography with slopes ranging from 0 to 15 percent. It occupies by far the largest area of any ecosystem on the Northern Great Plains.

Soils:

The soils are largely derived from silty shales, siltstones, and sandstones, although many are loams to clay loams. The long-term annual precipitation ranges from about 13 to 17 inches, depending upon location.

Vegetation:

This prairie ecosystem is distinguished from the mid-short grass prairie ecosystem primarily by the shift in dominance from mid- and short-grasses to mid-grasses. The climax stands may contain short grasses, but the mid-grasses are dominant. The major dominants include western wheatgrass, needle-and-thread, green needlegrass, and little bluestem. This ecosystem receives a slightly higher rainfall than mid-short grass types, and occurs on better developed soils.

Characteristic Plant Species

Agropyron smithii	western wheatgrass
Stipa comata	needle-and-thread
Stipa viridula	green needlegrass
Andropogon scoparius	little bluestem
Koeleria cristata	prairie junegrass
Bouteloua curtipendula	side oats grama
Bouteloua gracilis	blue grama
Sporobolus cryptandrus	sand dropseed
Andropogon gerardi	big bluestem
Oryzopsis hymenoides	Indian ricegrass
Artemisia tridentata	big sagebrush
Liatris punctata	blazing star
Psoralea tenuiflora	psoralea
Sphaeralcea coccinea	mallow
Oxytropis lambertii	crazyweed

Fauna:

This ecosystem has many of the same wildlife species common to the mid-short grass prairie ecosystem cited above. (See the Fish and Wildlife subgroup report.)

Ecosystem Interactions and Limitations:

While not as xeric as some ecosystems in the Northern Great Plains, the mid-grass prairie is very sensitive to disturbance. This sensitivity is most acute in the drier western portions of its range where rainfall averages about 13 to 14 inches per year. In

these areas, plant succession is extremely slow and will grade into short-grass or mid-short grass prairie conditions under moderate grazing pressure. Very little is known about plant succession on deep subsoil materials of this ecosystem. Sensitivity to disturbance is less severe in the eastern portions where average annual precipitation reaches about 17 inches. Natural secondary plant succession is somewhat more rapid in the eastern extremes although, again, very little is known about this phenomenon on deep lying geological materials.

6. Grassland-Sagebrush Ecosystem

The grassland-sagebrush ecosystem is widespread in southeastern Montana and northeastern Wyoming, occurring over most of the landscape in this part of the Northern Great Plains. It is an open to dense grassland type with scattered sagebrush. Küchler (1964) describes this ecosystem as a shrub steppe, but large areas support only scattered sagebrush with mixed grass prairie species as dominants. The average annual precipitation is about 10 to 14 inches, making it one of the driest types on the Northern Great Plains.

Topography:

These are undulating to rolling upland plains, sometimes with bedrock exposed on steeply sloping breaks bordering stream channels. Most of the area is of gentle slopes, but along stream beds slopes may exceed 100 percent.

Soils:

The soils are largely derived from interbedded sandstones, shales, and siltstones, and have silty or loamy textures. Some

localized areas of saline soils with clayey surfaces are common. (See the Soils subgroup report.)

Vegetation:

Vegetation of this ecosystem is characterized by short- and mid-grasses with scattered shrubs, mostly big sagebrush. The most important species include western wheatgrass, blue grama, needle-and-thread, green needlegrass, big sagebrush, fringed sagebrush, and skunkbush sumac. In some areas, particularly where high saline soils predominate, greasewood, saltgrass, and shadscale are dominants.

Characteristic Plant Species

Agropyron smithii	western wheatgrass
Bouteloua gracilis	blue grama
Stipa comata	needle-and-thread
Stipa viridula	green needlegrass
Koeleria cristata	prairie junegrass
Oryzopsis hymenoides	Indian ricegrass
Aristida longiseta	three-awn
Distichlis stricta	saltgrass
Agropyron spicatum	bluebunch wheatgrass
Gaura coccinea	goura
Koshia scoparia	summer cypress
Artemisia tridentata	big sagebrush
Artemisia frigida	fringed sagebrush
Atriplex confertifolia	shadscale
Sarcobatus vermiculatus	greasewood

Fauna:

Despite the xeric nature of this ecosystem, wildlife populations are complex and productive. (See the Fish and Wildlife subgroup report.)

Characteristic Animal Species

Antilocarpa americana	antelope
Centrocercus urophasianus	sage grouse
Lepus townsendii	jackrabbit
Taxidea taxus	badger
Pooecetes gramineus	vesper sparrow
Circus cyaneus	hawk
Canis latrans	coyote
Vulpes velox	red fox
Mephitis mephitis	skunk
Peromyscus maniculatus	white-footed mouse

Ecosystem Interactions and Limitations:

Low precipitation is the most important factor affecting vegetation yields in this ecosystem. On disturbed areas, short grasses and sagebrush increase and become dominants. Drought is very common in this type, as either low annual precipitation or as influenced by rainfall distribution. The semiarid climate in this area imposes a delicate balance between favorable and unfavorable growing conditions. A small drop below average precipitation may result in decline or complete failure of growth of all but the most drought-tolerant plants. During periods of drought, outbreaks of epidemic proportions of grasshoppers are

common in this and the mid-short grass and short-grass prairie ecosystems. Evidence indicates that both shrubs and grasses are severely affected, which in turn has a devastating impact on wildlife populations (Weaver and Albertson 1956). Rooting depths of grasses in this ecosystem are usually quite shallow, but the bulk of total plant biomass is produced in the roots. The growing season is normally terminated by drought during the late summer. Because of the prevalence of drought, this ecosystem is quite fragile and successional progress will respond only slowly to disturbance.

7. Sagebrush Steppe Ecosystem

The sagebrush steppe ecosystem is similar in many respects to the grassland-sagebrush ecosystem. It is characterized by an obvious physiognomic dominance of big sagebrush with a scattered understory of mixed grasses. It occurs principally in northern Wyoming and southeastern Montana where the annual average precipitation ranges from 12 to 14 inches.

Topography:

This ecosystem is on an undulating to rolling upland plain, topographically very similar to the grassland-sagebrush ecosystem.

Soils:

See the Soils subgroup report, and the soils description for grassland-sagebrush ecosystem.

Vegetation:

This ecosystem is dominated by big sagebrush with complex subdominant communities of grasses and forbs. The major ground cover is provided by the herbaceous vegetation, although shrubs are also important.

Characteristic Plant Species

Artemisia tridentata	big sagebrush
Artemisia arbuscula nova	black sagebrush
Bouteloua gracilis	blue grama
Agropyron spicatum	bluebunch wheatgrass
Oryzopsis hymenoides	Indian ricegrass
Stipa comata	needle-and-thread
Opuntia polycantha	prickly pear
Grindelia squarrosa	gumweed
Gutierrezia sarothrae	snakeweed
Aristida longiseta	three-awn

Fauna:

This ecosystem is an important habitat for a number of animals, including sage grouse and antelope, although lack of water prevents it from becoming highly productive for wildlife. Such predators as the coyote and foxes hunt these areas from adjacent ecosystems.

Characteristic Animal Species

Antilocarpa americana	antelope
Lepus townsendii	jackrabbit
Centrocercus urophasianus	sage grouse

Characteristic Animal Species (con.)

Taxidea taxus	badger
Onychomys leucogaster	grasshopper mouse
Sturnella veglecta	western meadowlark
Sorex vagrans obscurus	vagrant shrew
Sylvilagus audubonii	cottontail rabbit
Eutamias minimus	chipmunk
Thomomys talpoides	pocket gopher
Dipodomys ordii	kangaroo rat
Peromyscus maniculatus	deer mouse
Lagurus curatus levidensis	sagebrush vole
Canis latrans	coyote
Vulpes regalis	red fox
Lynx rufus pallecens	bobcat

Ecosystem Interactions and Limitations:

This is a highly xeric ecosystem subject to regular drought, and hence is not highly productive. It is a widely expressed opinion by many ecologists that this ecosystem represents a disclimax, and that the abundance of big sagebrush is attributable to past grazing (Weaver and Clements 1938; Weaver and Albertson 1956). Others feel that big sagebrush is a legitimate climax species that has managed to occupy ecological niches to which it is best adapted. Indeed, in many respects, big sagebrush is a stable species that demonstrates many potential advantages for revegetation of disturbances. Unfortunately, this shrub has been

the subject of much bias among ecologists because of its generally low forage value. In a purely ecological sense, however, there is nothing "inferior" about big sagebrush. Indeed, judged purely on its ecological adaptability and physiological tolerances, big sagebrush is a very successful and superior plant. All native species in this ecosystem, although generally slow growing, are potentially very useful for rehabilitating disturbed areas.

8. Grassland-Sandsage Ecosystem

The grassland-sandsage ecosystem is represented by a small disjunct area in the southwest corner of Wyoming. The area has hummocky to sand dune topography with well drained soils. Average annual precipitation is about 12 to 14 inches, and the soils are characterized by Aandahl association 181. Vegetation of this ecosystem, although not known in detail, consists of medium and tall grasses (except big bluestem) including little bluestem, blue grama, prairie sandreed, buffalo grass,sand dropseed, and needle-and-thread. Important shrubs include sandsage and big sagebrush. Very few data are available concerning the wildlife in this ecosystem.

Information concerning this ecosystem on the Northern Great Plains is scarce and consequently very little can be said about it at this time. This ecosystem is particularly subject to wind erosion, and drought has a severe effect on plant species composition.

9. Mid-Tall Grass Prairie Ecosystem

The mid-tall grass prairie occurs only in the northeastern portion of North Dakota. This is a dense, medium tall to tall grassland representing a transition between the mid-grass prairie to the west and the tall-grass prairie to the east. This ecosystem receives average annual precipitation of about 16 to 22 inches, and represents the wettest grassland ecosystem in the Northern Great Plains.

Topography:

Nearly level to very gently rolling or undulating glacial lake basin and outwash plain characterizes this ecosystem. The dominant slopes range between 0 and 3 percent.

Soils:

The soils of this ecosystem are largely loams originating from glacial till. These soils correspond with Aandahl soil associations 7, 9, 15, 16, 19, and 32.

Vegetation:

The most striking characteristic of this ecosystem that distinguishes it from other grasslands is the presence of such tall grasses as big bluestem. Such short grasses as blue grama are rarely found; mid-grasses are common.

Characteristic Plant Species

Agropyron smithii	western wheatgrass
Andropogon gerardi	big bluestem

Characteristic Plant Species (con.)

Andropogon scoparius	little bluestem
Stipa spartea	needlegrass
Carex filifolia	threadleaf sedge
Agropyron trachycaulum	slender wheatgrass
Agropyron dasystachyum	thickspike wheatgrass
Koeleria cristata	prairie junegrass
Stipa viridula	green needlegrass
Stipa comata	needle-and-thread
Artemisia frigida	fringed sagebrush
Rosa arkansasana	Arkansas rose
Solidago missouriensis	Missouri goldenrod
Carex filifolia	threadleaf sedge
Bouteloua curtipendula	side-oats grama
Hordeum pusillum	little barley

Fauna:

See the Fish and Wildlife report.

Ecosystem Interactions and Limitations:

This is the wettest grassland ecosystem on the Northern Great Plains and has the most thoroughly developed soils. It plays an important role as a primary producer of forage for both domestic and wildlife animals. Sensitivity to disturbance is relatively high, but it has a greater potential for recovery than most other grassland ecosystems by virtue of the higher precipitation. On the western fringes of this ecosystem, the tall bluestem communities

are restricted to the more mesic sites as in ravines and lower slopes. The drier slopes and ridges in the western portion support stands dominantly of western wheatgrass and needlegrass. Further east, particularly where precipitation exceeds 18 to 20 inches, the true tall-grass prairie becomes evident. In this ecosystem, unlike other grassland types, the root-shoot ratio approaches 1.0 as greater amounts of biomass are produced by aboveground tissues. Rooting depths are also much greater than in other grassland ecosystems.

10. Foothills Grassland Ecosystem

The foothills grassland ecosystem borders the grassland-sagebrush ecosystem, and occurs on hillsides and mountains below forested slopes. It occurs on only a small area of the total NGPRP study area, principally in Montana and along the Big Horn Mountains in Wyoming. The primary plant species include wheatgrasses and fescue, although big sagebrush is often also present.

Topography:

This ecosystem occurs on rolling and sloping foothills below forested slopes above, and above the grass-sagebrush prairie below.

Soils:

The soils are generally deep and well drained, formed over clay shales. In some areas they consist of about 30 percent gravels. The average annual precipitation in these areas is about 15 to 18 inches.

Vegetation:

The vegetation of this ecosystem is typically composed of grasses and forbs, although shrubs are not uncommon. Common grasses include wheatgrass, fescue, and needlegrasses, whereas forbs include balsamroot, yarrow, and lupine. Typical shrubs include sagebrush and shrubby cinquefoil, although skunkbush sumac is locally abundant in some areas. In some areas, not shown on the map in Appendix E because of its small area, this ecosystem gradually is replaced by a savannalike grassland with ponderosa pine and Douglas-fir.

Characteristic Plant Species

Agropyron spicatum	bluebunch wheatgrass
Festuca idahoensis	Idaho fescue
Agropyron smithii	western wheatgrass
Stipa viridula	green needlegrass
Stipa comata	needle-and-thread
Koeleria cristata	prairie junegrass
Poa secunda	Sandberg bluegrass
Stipa columbiana	Columbia needlegrass
Balsamorhiza sagittata	balsamroot
Achillea millefolium	yarrow
Lupinus sericeus	silky lupine
Artemisia tridentata	big sagebrush
Artemisia cana	silver sagebrush
Artemisia frigida	fringed sagebrush
Potentilla fruticosa	shrubby cinquefoil
Rhus trilobata	skunkbush sumac

Fauna:

This ecosystem serves as important summer range for deer, elk, and other herbivores. Blue grouse and sage grouse occur extensively. It is a relatively complex ecosystem, used by a wide variety of birds and mammals, particularly in the summer.

Characteristic Animal Species

Odocoileus hemionus	mule deer
Cervus canadensis	elk
Canis latrans	coyote
Taxidea taxus	badger
Citellus armatus	ground squirrel
Mephitis mephitis	skunk
Vulpes velox	fox
Peromyscus maniculatus	whitefooted mouse
Sturnella neglecta	western meadowlark
Pooecetes gramineus	vesper sparrow
Falco sparverius	sparrow hawk
Pediocetes gramineus	sharptail grouse
Dendragapus obscurus	blue grouse

Ecosystem Interactions and Limitations:

Vegetation cover is very important for erosion control and for increasing infiltration in the soils. The microclimate of this ecosystem is drier and warmer than the forest types above, and slightly more mesic and cooler than the prairie below. The most fragile areas are along ecotones between forest and grass types, where wildlife habitat is particularly important. Sagebrush stands

along forest types are important for elk calving range, and provide excellent bird habitat. Grasshoppers can be detrimental to the ecosystem, but provide protein for blue grouse, birds, and rodents. Sulfur butterflies feed on clover growing in moist areas, and bumblebees are common and typical since they nest in the ground and live on the nectar of various flowers. A balance among grasses, forbs, micro-organisms, insects, birds, herbivores, and carnivores is essential to stability in this ecosystem.

11. Prairie-Oak Savanna Ecosystem

The prairie-oak savanna ecosystem occurs as relatively small communities in the northeastern corner of North Dakota. Very little available information concerning this ecosystem can be documented at this time. It occurs on gently rolling topography with an average annual precipitation of about 17 to 20 inches. The soils of this ecosystem are described by Aandahl associations 1, 16, and 181.

The vegetation of this type is composed of tall and mid-grasses such as big bluestem, little bluestem, prairie sandreed, and of such trees as bur oak and green ash, and such shrubs as rose. This type is described by Küchler (1964) as type No. 81.

12. Ponderosa Pine Forest Ecosystem

The ponderosa pine forest ecosystem is the most common forest type on the Northern Great Plains, and is spread throughout eastern Montana, western North and South Dakota, and northeastern Wyoming. In some respects, this ecosystem is quite similar to the forests of the Black Hills, but for the most part retains a unique character that sets it apart.

Topography:

This ecosystem is found on sloping to steep topography ranging in gradient from about 10 to 40 percent. It is located primarily on the crests of hills and ridges and where uplands break into drainageways. Ponderosa pine occurs most commonly on north slopes where temperature and water availability are favorable. Occasionally, it is also found along the bottom slopes of badland topography on the weathered remains of sandstone outcrops.

Soils:

Ponderosa pine occurs on predominately shallow and loamy soils that have developed in weathered porcellanite or sandstone. These soils may be shallow to deep, are well drained, droughty, moderately fertile, and have a high to moderate erosion hazard.

Vegetation:

Ponderosa pine is the principal plant species, occurring in dense to open stands. On moist sites the understory consists of such shrubs as snowberry and grasses including Sandberg bluegrass, plains muhly, and prairie junegrass. On drier sites the understory consists of silver sagebrush, side-oats grama, bluebunch wheatgrass, and needle-and-thread. Some plant communities contain Rocky Mountain juniper, often associated with the most mesic badland plant communities. Ponderosa pine-savanna is common along rimrock crests lining the upper breaks above badland topography.

Characteristic Plant Species

Pinus ponderosa	ponderosa pine
Symphoricarpos occidentalis	western snowberry

Characteristic Plant Species (con.)

Juniperis horizontalis	horizontal juniper
Juniperus scopulorum	Rocky Mountain juniper
Rhus trilobata	skunkbush sumac
Artemisia cana	silver sagebrush
Bouteloua curtipendula	side-oats grama
Stipa viridula	green needlegrass
Carex filifolia	threadleaf sedge
Poa secunda	Sandberg bluegrass
Agropyron spicatum	bluebunch wheatgrass
Muhlenbergia cuspidata	plains muhly
Andropogon scoparius	little bluestem
Carex eleochous	needleleaf sedge

Fauna:

The ponderosa pine ecosystem often supports a significantly different environment than immediately surrounding types. It provides cover and nesting habitat for many animals that might otherwise not exist on the Northern Great Plains. In some respects, this ecosystem is far more complex than grassland or shrub ecosystems because of the rich fauna occupying different vegetation strata beneath the ponderosa pine canopy. Mesic areas support a definite overstory of pine with a shrub layer beneath and a grass-forb strata close to the soil surface. In addition, a humus layer on the soil surface may be evident in some areas. Each of these layers provides important habitat for birds, insects, rodents, and micro-organisms vital to the stability of this ecosystem.

Characteristic Animal Species

Odocoileous hemionus	mule deer
Pryocyon lotor	raccoon
Vespes regalis	red fox
Canis latrans	coyote
Eutamias minimus borealis	northern chipmunk
Mephitis hudsonica	plains skunk
Peromyscus maniculatus	white-footed mouse
Buteo jamaicensis	red-tailed hawk
Lynx rufus	bobcat
Mustela longicauda	long-tailed weasel
Aquila chrysaetos	golden eagle
Asyndesmus lewis	woodpecker
Turdus migratorius	robin

Ecosystem Interactions and Limitations:

This ecosystem is the primary recharge area for water to springs and streams. Therefore, keeping them in good vegetative condition is a prime management objective. This type is highly susceptible to overuse and runoff. The average annual precipitation ranges from about 12 to 17 inches. Ponderosa pine reaches the northeastern extreme of its range in this area, and occupies a rather sensitive niche on the Great Plains. In some areas, evidence indicates that climatic shifts to more xeric conditions encourage invasion by grassland types at the expense of forest vegetation. However, in other areas the restriction of grazing permits ponderosa pine invasion into grasslands.

13. Black Hills Ponderosa Pine Ecosystem

The Black Hills ponderosa pine ecosystem occurs in the Black Hills of western South Dakota and eastern Wyoming. While this ecosystem has the same dominant plant species as the ponderosa pine forest ecosystem, it has a much richer and more complex floristic structure. Also, its animal habitats are far more complex and numerous and it has a much larger resident wildlife population. The average annual precipitation in the Black Hills ranges from 18 to about 26 inches, which is considerably greater than the ponderosa pine forest ecosystem.

Topography:

This ecosystem is gently rolling, especially in the northwestern section where limestone forms a plateau above 6,000 feet elevation. Several points on the plateau exceed 7,000 feet. Steep cliffs, several hundred feet high, occur along the discontinuity between limestone and adjacent formations, and along river canyons (Thilenius 1972).

Soils:

Soils at lower elevations are derived from sandstone shales, whereas mid-elevation soils are formed over limestone and calcareous sandstone. Upper elevation soils are derived from metamorphic quartz-mica schists. In some areas, igneous intrusions are common.

Vegetation:

Approximately 1.2 million acres of Black Hills forest are dominated by ponderosa pine (Thilenius 1972). Almost the entire forest is in some stage of plant succession resulting from disturbance.

Thilenius (1971) describes 18 vegetation types in the Black Hills, but ponderosa pine is by far the most extensive and typical. He further subdivides the ponderosa pine type into six subtypes, delineated on the basis of the subdominant understory. Obviously, the Black Hills ponderosa pine ecosystem is a highly complex system, and the following list of plant species is not at all complete.

Characteristic Plant Species

Pinus ponderosa	ponderosa pine
Picea glauca	white spruce
Pinus contorta	lodgepole pine
Pinus flexilis	limber pine
Populus tremuloides	aspen
Quercus macrocarpa	bur oak
Acer negundo	box elder
Fraxinus pennsylvanica	green ash
Cercocarpus montanus	mountain mahogany
Artemisia tridentata	big sagebrush
Symphoricarpos occidentalis	western snowberry
Salix bebbiana	willow
Ceanothus velutinus	snowbrush
Juniperus communis	common juniper
Arctostaphylos uva-ursi	kinnikinnick
Yucca glauca	yucca
Artemisia frigida	fringed sagebrush
Agropyron smithii	western wheatgrass
Agropyron spicatum	bluebunch wheatgrass

Characteristic Plant Species (con.)

Bouteloua curtipendula	side-oats grama
Andropogon scoparius	little bluestem

Fauna:

Thilenius (1972) estimates that in 1968 there were more than 120,000 white-tailed and mule deer in the Black Hills deer herd. A list of characteristic animal species for this ecosystem was not available at this writing, but the Fish and Wildlife subgroup report can be consulted for updating.

Ecosystem Interactions and Limitations:

The Black Hills is an elliptically shaped islandlike dome covering about 2,900 square miles. Drainage is primarily to the east and southeast; no natural lakes are in the area. At higher elevations the annual snowfall may exceed 110 inches. Temperature inversions are very common in the winter, and may be accompanied by warm chinook winds. The vegetation types of the Black Hills have been disturbed to some extent in the past by fire, grazing, logging, and mining (Thilenius 1972). The ponderosa pine forests of this area are relatively homogeneous in terms of a closed canopy tree overstory. An important characteristic of this ecosystem is the low number of species in the overstory, and the unusually rich flora of the understory.

14. Douglas-Fir Ecosystem

The Douglas-fir ecosystem occurs on limited areas, primarily along the eastern slopes of the Big Horn Mountains and on the Big Snowy Mountains.

Topography:

This ecosystem occurs on mountain slopes at higher elevations and (relative to the Northern Great Plains) usually on fairly steep slopes.

Soils:

Most soils are deep and well drained, with high fertility and organic matter. These soils are derived from limestone, and are either clay loams or silt loams.

Vegetation:

This ecosystem displays a high degree of variation depending upon the stage of plant succession. At lower elevations it is confined to north exposures, but at higher elevations Douglas-fir occurs on south exposures. Lodgepole pine is the seral species and is common at higher elevations or in areas of disturbance.

Characteristic Plant Species

Pseudotsuga menziesii	Douglas-fir
Symphoricarpos alba	snowberry
Spiraea betulifolia	spirea
Physocarpus malvaceus	ninebark
Berberis repens	barberry
Arnica cordifolia	heartleaf arnica

Characteristic Plant Species (con.)

Balsamorhiza sagittata	balsamroot
Calamagrostis rubescens	pinegrass
Carex geyeri	elk sedge
Festuca idahoensis	Idaho fescue
Agropyron spicatum	bluebunch wheatgrass
Danthonia intermedia	timber oatgrass
Achillea millefolium	yarrow
Rosa woodsii	woods rose
Arctostaphylos uva-ursi	kinnikinnick
Prunus virginiana	chokecherry

Fauna:

This ecosystem supports a large variety of animals including mammals, rodents, birds, and insects. Most big game such as deer, elk, bighorn sheep, and bear are found at some time during the year.

Characteristic Animal Species

Euarctos americanus	black bear
Cervus canadensis	elk
Odocoileus hemionus	mule deer
Erethizon epixanthum	porcupine
Dendragapus obscurus	blue grouse
Corvus coras	raven
Dendrocopus willosus	woodpecker
Lepus americanus	snowshoe rabbit
Tamiasciurus hudsonicus	pine squirrel

Characteristic Animal Species (con.)

Eutamias minimus	chipmunk
Ovis canadensis	bighorn sheep
Lynx uinta	bobcat
Felix oregonensis	cougar
Bonasa umbellus	ruffed grouse

Ecosystem Interactions and Limitations:

The Douglas-fir ecosystem on the Northern Great Plains represents the easternmost extension of its type. It is sensitive to disturbance and requires longer periods of succession to reach climax than in the western Rocky Mountains. This type requires a warmer microclimate than subalpine types, and its tolerance to shade is intermediate. It depends on the humus-enriched soil for establishment, as well as low surface temperatures and partial shading. This ecosystem is an area where most bear denning occurs, and therefore is important for providing winter cover. Its potential for recovery following disturbance is moderate. Bark beetles cause considerable damage in some stands of Douglas-fir, wherein such insect-eating birds as woodpeckers and nut-hatches play a vital ecological role.

15. Ponderosa Pine--Douglas-Fir Ecosystem

The ponderosa pine--Douglas-fir ecosystem occurs primarily in the extreme southern reaches of the study area in the Laramie Mountains. Geographically, it is a very small area of the Northern Great Plains. Although insufficient information is available at this time to prepare a detailed description of this type, it has

many characteristics similar to the Douglas-fir and the ponderosa pine ecosystems. It supports a rich biota of grasses including bluebunch wheatgrass, Idaho fescue, pinegrass, and mountain muhly. Forbs and shrubs abound. It also supports an abundant animal population of deer, bear, and other mammals, rodents, birds, and insects.

16. Subalpine Ecosystem

The subalpine ecosystem only occurs at high elevations above about 7,000 feet in the Big Snowy Mountains, the Big Horn Mountains, and the Laramie Mountains of the study area.

Topography:

Slopes range from 10 to nearly 100 percent, on steep rocky areas to gently sloping terrain.

Soils:

Soils have developed from limestone or silt and sandstone shales in an average annual precipitation exceeding 24 inches. Textures are usually light, including loams to sandy loams, and are often stony, with a slightly acid pH.

Vegetation:

Vegetation of this ecosystem reflects the relatively short growing season of about 90 days and cool growing season temperatures. The subalpine forest represents the highest extension of forest trees, which are usually stunted in growth. Subalpine meadows occur in cool moist areas and consist of shrubs, grasses, and forbs.

Characteristic Plant Species

Pinus contorta	lodgepole pine
Abies lasiocarpa	subalpine fir
Pseudotsuga menziesii	Douglas-fir
Picea engelmanni	Engelmann spruce
Potentilla fruticosa	shrubby cinquefoil
Potentilla glandulosa	gland cinquefoil
Ribes montigenum	gooseberry
Vaccinium scoparium	red huckleberry
Deschampsia caespitosa	hairgrass
Poa alpina	alpine bluegrass
Trisetum spicatum	spike trisetum
Arnica mollis	arnica
Erigeron simplex	fleabane
Carex geyeri	elk sedge

Fauna:

This ecosystem provides important animal habitat because of the variety of cover types. Rocky breaks, patches of timber, and meadows supply a variety of cover and forage for mammals, rodents, birds, and insects.

Characteristic Animal Species

Aquila chrysaetos	golden eagle
Corvus corax	raven
Junco-oreganus	Oregon junco
Sialia currucoides	mountain bluebird

Characteristic Animal Species (con.)

Turdis migratorus	robin
Dendragapus obscurus	blue grouse
Lepus americanus	snowshoe rabbit
Eutamias minimus	chipmunk
Odocoileus hemionus	mule deer
Cervus canadensis	elk
Euarctos americanus	black bear
Peromyscus maniculatus	deer mouse
Falco peregrinus	falcon

Ecosystem Interactions and Limitations:

Timber in this ecosystem is not of sufficient quality to be used as lumber. But it is essential as cover for animals of all types, and many species of birds depend upon the dense foliage for nesting. The trees trap blowing snow from exposed ridges and plateaus; thus, they have an important function in this ecosystem in terms of water table recharge and ecosystem water relations. Shrubs, forbs, and grasses in meadows provide important habitat for birds, rodents, and insects. This ecosystem is particularly fragile and very sensitive to disturbance, thus rendering it very difficult to rehabilitate because of the short growing season, cool temperatures, and general lack of well developed soils.

IV. INTERPRETATIONS

Obviously, a comprehensive analysis of the ecosystems of the Northern Great Plains is not achieved in this report. Fundamental inventory data are completely lacking in some areas (e.g., lists of plant and animal species, soils data, climatic data); thus, gaps in essential information exist. However, inventory data alone are insufficient to assess ecosystem interactions and limitations. To merely list plant and animal species, describe soil types and topography, and generalize the climate of an area does not present an analysis of ecosystems. Oftentimes the available data or information is so sparse that "making your best estimate" is not only insufficient, but may be ecologically disastrous.

A concerted effort, involving teams of scientists, is needed to evaluate the interactions of ecosystem components that involve the roles of producers, consumers, decomposers, and physical environmental factors. Much may be known about primary producers and consumers, such as the dominant vegetation and larger wildlife species, but these constitute only a small part of the ecosystem. In most cases, we know frighteningly little about such less obvious components as insects and micro-organisms, which may be equally, if not more, important than the larger organisms. Thus it is incumbent that an all-out effort be designed to investigate these basic questions before logically and ethically the job is truly complete.

Climatic and Other Abiotic Interpretations:

The climate of the Northern Great Plains is one of extremes. Commonly, it is semiarid or midcontinental, but at times it may be humid or desertlike (Weaver and Albertson 1956). This region is subject to extremes of both temperature and precipitation, and experiences some of the highest average wind velocities in the United States.

Along the Rocky Mountains to the west, precipitation on the rolling grasslands averages from 10 to 14 inches, whereas further east precipitation progressively increases to more than 24 inches. Sudden severe thunder and hailstorms commonly occur in the summer, and driving blizzards in the winter, with temperatures dropping far below zero.

Of all the extreme climatic variables common to the Northern Great Plains, none has a greater ecological impact than the ubiquitous threat of drought. Historical records of drought in this region cast a sobering shadow over the dreams of quick restoration of complex ecosystems following disturbance. With unpredictable regularity, drought wipes out vast acreages of mesic vegetation and exposes the soil to erosion by high winds. Short periods of drought occur nearly every growing season, but general drought with devastating consequences lasting for several years can be expected nearly every 20 years. Recovery from drought is very slow, beginning with the plant cover, and eventually extending to the return of animals, birds, insects, and to the development of soil itself.

Biotic Interpretations:

Obviously, plants and animals are not exclusively self-sufficient. The most obvious interrelationship is one of food: plants are producers, animals are consumers (either of plants or of animals that eat plants). The food chain in natural ecosystems is quite complex (see Van Dyne 1969a, 1969b; Dix and Beidleman 1969; Humphrey 1962; Krebs 1972). Other interrelations include shelter for animals by plants, symbiotic relations, parasitism, and competition. Such relationships among vascular plants as competition, growth requirements, ecology, and others as well as the relationships between vascular plants and animals are widely discussed elsewhere and need not be further discussed here (Weaver and Albertson 1956; Weaver 1954, 1968; Dix and Beidleman 1969; Van Dyne 1969b; Brown 1971; Küchler 1973; Thilenius 1971, 1972). (Also see the Fish and Wildlife subgroup report.)

A brief discussion of the role of insects and of micro-organisms in ecosystems is in order. These organisms are stressed because of the vital role they play, and because they are not obvious to the casual observer of ecosystems. The importance of vascular plants, large animals, climate, soils, topography, and other macrocomponents is obvious and has been stressed throughout this and other NGPRP reports. However, the importance of insects and micro-organisms has not been stressed.

Insects

The complex role played by insects in ecosystem dynamics is enormous and yet, as cited by Blocker (1969), this role has been

largely neglected by ecologists. Insects are normally looked upon as parasites or pests (National Academy of Sciences 1969), but closer inspection reveals that this is a far too simple and convenient assessment. Insects are intricately tied into the complex web of ecosystem components as consumers, parasites on both plants and animals, and as decomposers.

Insects have a greater impact on vegetation as herbivores than all other animals combined because of their vast numbers (Parker 1973). They consume nearly every kind of plant product including living and dead tissue. Many insects produce galls on some vegetation that are, in turn, fed upon by other insects. This role, in addition to contributing to the recycling of plant material in the ecosystem, also has obvious additional benefits. For instance, harvester ants are important agents in seed dispersal, and the prickly pear moth exerts a decisive influence on the spread of plains prickly pear.

Thousands of species of bees, bumble bees, and wasps nest in the soil. Implications to strip mining are evident because of the role played by these insects in pollination and soil organic matter production. Most flowering plants depend upon specific insects for pollination, and instances occur where total dependency exists between plant propagation and insect activity. Many soil-nesting insects use large volumes of plant material for nest construction, which contributes organic matter to the soil. When one considers that many thousands of insects per acre may be involved, the magnitude of their importance can be better appreciated.

Where rare or endangered plant species exist, or where endemic populations grow, vital interactions between insects and plants come into focus. Mutual dependency exists between insects and plants in such restricted areas and are of such delicate balance that any disturbance resulting in the elimination of one group of organisms would likely preclude the existence of the other. Some relationships between insects and plants are so complicated and delicate that in most instances neither plant nor insect could live long apart.

Not all insects prey on plants alone. Some, such as fleas, lice, gnats, midges, mosquitos, some beetles, ants, and wasps, feed on other animals including insects. Occasionally, insects are important vectors of disease to both animals and plants; they also play a major role in helping control the population density of both plants and animals, and thus contribute to the regulation of ecosystem dynamics.

These examples only hint at the multitude of ways that insects contribute to ecosystem interactions and dynamics, but emphasize the need for additional research to better illustrate other seemingly subtle interdependencies.

Soil Micro-Organisms

The release of nutrients in the soil for use by vascular plants from dead organic matter, soil, rock elements, and atmospheric gases is brought about by physical, chemical, and biological processes. However, the rate of release would be totally inadequate to maintain the extensive plant populations of the world were it not for the

biological activity of soil micro-organisms (Gray and Williams 1971). Soil micro-organisms collectively are referred to as decomposers; they obtain their energy by heterotrophic adsorption of decomposition products, and include such organisms as the fungi, bacteria, viruses, algae, and actinomycetes.

Dead plant and animal tissues are decomposed by soil micro-organisms which, through high rates of metabolism coupled with high enzymatic reaction rates, release bound nutrients into the ecosystem for recycling. Thus, such elements as carbon, nitrogen, phosphorus, and others are made available for absorption and assimilation. In addition, some micro-organisms are essential, or at least beneficial, for absorbing and assimilating released nutrients; for example, certain bacteria and actinomycetes organisms are responsible for "nitrogen fixation" in plants. In this process, free atmospheric nitrogen is made available for vascular plant growth. Some fungi form symbiotic associations with many plants, resulting in a formation known as mycorrhiza.

Besides soil micro-organisms, other important micro-organisms interact within the tissues of vascular plants and animals. The entire area of plant pathology plays a vital role in holding plant populations, and ultimately some animals, in check. Some micro-organisms significantly affect animal metabolism, and are the culprits involved in diseases.

Because micro-organisms are rarely seen, the importance they play in ecosystem dynamics is obscured. However, without them there

would be no ecosystems on this earth. But impending demands for energy require more awareness of the decomposer. Extensive mineral development emphasizes the need for a realization of the effects these activities will have on the micro-organism balance. For example, what effects will mining have on the soil water balance, gaseous diffusion into and out of mined materials, soil chemistry, soil temperature, and other factors that directly impinge upon micro-organism activity? Also, will rehabilitation provide a suitable micro-organism habitat in which successful ecosystem rebuilding can begin? Data are insufficient now to assess the impact of extensive mineral development on micro-organism activities and its ultimate effect on ecosystem stability.

Rare and Endangered Species of the Northern Great Plains

A rare and endangered plant species list for the Northern Great Plains has been prepared by Schumacker (1972), primarily for South Dakota. Presumably, these species would be endangered in any location in the Northern Great Plains where their occurrence approached the limits of their ecological and physiological tolerances. Some species, such as endemics, would be in greater danger of extinction if they were in areas likely to be disturbed by surface mining. These plant species, the result of countless generations of natural selection and evolution, should be retained. It is likely that some of these species possess the potential of producing hybrids capable of successful colonization on disturbed areas; therefore, an effort is needed to further study species on this list for potential use in surface mine reclamation.

The following list of rare and endangered species, many of which are specific for certain species of insects, was taken from Schumacher (1972). (Rare and endangered wildlife species have been identified and discussed by the Fish and Wildlife subgroup.)

Plant Characteristics	Scientific Name & Authority	Common Name
Occurrence:	Alluvial woods - mostly eastern (LRA 102 & 56)	
Tree	Gymnocladus dioica (L.) Koch	Kentucky coffeetree
"	Ulmus thomasi Sarg.	Rock elm
Per.Forb	Agastache nepetoides (L.) Ktze	Gianthyssop
"	Boehmeria cylindrica (L.) Sw.	Smallspike falsenettle
"	Desmodium illinoenensis Gray	Illinois tickclover
"	Helenium autumnale L.	Common sneezeweed
"	Phlox divaricata L.	Sweetwilliam phlox
An.Forb	Pilea pumila (L.) Gray	Clearweed
Grass	Brachyelytrum erectum (Schreb) Beauv.	Bearded shorthusk
"	Cinna arundinacea L.	Stout woodreed
"	Diarrhena americana Beauv.	American beakgrain
"	Leersia virginica Willd.	Whitegrass
"	Muhlenbergia frondosa (Poir) Fern.	Wirestem muhly
"	Poa sylvestris Gray	Woodland bluegrass
Gr.-like	Carex crisatella Britt.	Sedge
"	Carex sparganioides Muhl.	Sedge
Occurrence:	Loamy upland woods - mostly eastern (LRA 102 & 55)	
Tree	Acer saccharum Marsh	Sugar maple
"	Euonymous atropurpureus Jacq.	Eastern wahoo
Shrub	Corylus cornuta Marsh	Beaked hazelnut
Per.Forb	Aralia racemosa L.	American spikenard
"	Asarum canadense L.	Canada wildginger
"	Caulophyllum thalictroides (L.) Michx.	Blue cohosh
"	Cryptotaenia canadensis (L.) DC.	Honewort
"	Erythronium albidum Nutt.	White fawnlily
"	Isopyrum biternatum (Raf.) T. & G.	Atlantic isopyrum
"	Panax quinquefolium L.	American ginseng
"	Prenanthes alba L.	White rattlesnakeroot
"	Ranunculus micranthus Nutt.	Buttercup
"	Taenidia integerrima (L.) Drude	Yellow taenidia
"	Trillium cernuum L.	Nodding trillium
"	Trillium nivale Riddell	Dwarf trillium
"	Uvularia sessilifolia L.	Little merrybells
Grass	Hystrix patula Moench.	Bottlebrushgrass
"	Milium effusum L.	American milletgrass
Gr.-like	Carex assiniboinensis Boott.	Sedge
"	Carex convoluta Schk.	Sedge
"	Carex pedunculata Muhl.	Sedge

Plant Characteristics	Scientific Name & Authority	Common Name
	Occurrence: Lowland prairie - mostly eastern (LRA 102 & 55)	
Shrub	Spiraea alba Duroi	Meadowsweet spiraea
Per.Forb	Asclepias sullivantii Engelm.	Sullivant milkweed
"	Asclepias tuberosa L.	Butterfly milkweed
"	Boltonia asteroides (L.) L'Her.	White boltonia
"	Callirhoe involucrata (T. & G.) Gray	Purple poppymallow
"	Coreopsis palmata Nutt.	Finger coreopsis
"	Cypripedium candidum Muhl.	White ladyslipper
"	Gentiana andrewsii Griseb.	Andrews gentian
"	Gentiana puberulenta Pringle	Downy gentian
"	Hieracium canadense Michx.	Canada hawkweed
"	Hypoxis hirsuta (L.) Cov.	Goldstargrass
"	Lespedeza capitata Michx.	Roundhead lespedeza
"	Lilium superbum L.	Turkscap lily
"	Prenanthes aspera Michx.	Rough rattlesnakeroot
"	Pycnanthemum virginianum (L.) D. & J.	Virginia mountainmint
"	Silphium integrifolium Michx.	Wholeleaf rosinweed
"	Spiranthes cernua (L.) Rich	Nodding ladiestresses
"	Trifolium beckwithii Brew.	Beckwith clover
"	Veronicastrum virginicum (L.) Farw.	Culversroot
Gr.-like	Carex bebbii Olney	Sedge
	Occurrence: Swales, marshes and potholes over the state.	
Per.Forb	Caltha palustris L.	Common marshmarigold
"	Campanula aparinoides L.	Bedstraw bellflower
"	Crepis occidentalis Nutt.	Western hawksbeard
"	Lobelia spicata L.	Palespike lobelia
"	Menyanthes trifoliata L.	Common bogbean
"	Triglochin concinnum Davy	Arrowgrass
An.Forb	Myosurus minimus L.	Tiny mousetail
"	Polygonum sagittatum L.	Arrowleaf tearthumb
Grass	Catabrosa aquatica (L.) Beauv.	Brookgrass
"	Spartina gracilis Trin.	Alkali cordgrass
"	Zizania aquatica L.	Wildrice
Gr.-like	Carex bicknellii Britt.	Bicknell sedge
"	Carex intumescens Rudge	Sedge
"	Carex retrorsa Schw.	Sedge
"	Carex stipata Muhl.	Awlfruit sedge
"	Eleocharis engelmannii Steud.	Engelmann spikesedge
"	Eleocharis intermedia (Muhl.) Schultes	Matted spikesedge
"	Juncus acuminatus Michx.	Rush
"	Juncus alpinus Vill	Alpine rush
	The following are in water either emergent or submersed:	
Per.Forb	Acorus calamus L.	Sweetflag
"	Heteranthera limosa (SW.) Willd.	Mudplantain
"	Zosterella dubia (Jacq.) Small	Water stargrass
An.Forb	Polygonum punctatum Ell.	Dotted smartweed
Gr.-like	Carex comosa Boott.	Bristly sedge
"	Carex lacustris Willd.	Lakebank sedge
"	Carex vesicaria L.	Blister sedge
"	Eleocharis compressa Sulliv.	Flatstem spikesedge
"	Scirpus heterochaetus Chase	Slender bulrush

Plant Characteristics	Scientific Name & Authority	Common Name
Occurrence: Sands and Sandy sites - Southcentral part of state		
Shrub	Ceanothus ovatus Desf.	Inland ceanothus
Per.Forb	Asclepias arenaria Torr.	Sand milkweed
"	Monarda pectinata Nutt.	Spotted beebalm
"	Psoralea linearifolia T. & G.	Narrowleaf scurfpea
"	Thelypteris palustris Schott.	Marshfern
An.Forb	Cristatella jamesii T. & G.	Cristatella
"	Froelichia floridana (Nutt.) Moq.	Field snakecotton
"	Gilia longiflora (Torr.) G. Don	Whiteflower gilia
"	Mentzelia dispersa Wats.	Mentzelia
"	Polanisia trachysperma T. & G.	Roughseed clammyseed
Gr.-like	Cyperus filiculmis Vahl.	Fern flatsedge
	Rhynchospora capillacea Torr.	Beakrush
Occurrence: Upland prairie - over the state		
Shrub	Salix tristis Ait.	Dwarf pussywillow
Per.Forb	Asclepias stenophylla Gray	Narrowleaf milkweed
"	Astragalus barrii Barneby	Milkvetch
"	Astragalus mollissimus Torr.	Woolly loco
"	Astragalus pectinatus (Hook) G. Don	Narrowleaf milkvetch
"	Astragalus vexilliflexus Sheld.	Milkvetch
"	Gilia spicata Nutt.	Spike gilia
"	Lomatium nuttallii (Gray) MacBride	
"	Mentzelia oligosperma Nutt.	Stickleaf
"	Psoralea digitata Nutt.	Finger scurfpea
"	Silphium laciniatum L.	Compassplant
Bi-Forb	Chaenactis douglasii (Hook) H. & A.	Falseyarrow
Grass	Agrostis perennans (Walt.) Tuckerm.	Autumn bentgrass
"	Calamagrostis montanensis Scribn.	Plains reedgrass
"	Sporobolus heterolepis A. Gray	Prairie dropseed
Gr-like	Carex pennsylvanica Lam.	Penn sedge

Plant Characteristics	Scientific Name & Authority	Common Name
Occurrence: Black Hills (LRA 62)		
Tree	Pinus contorta var. latifolia Engelm	Lodgepole pine
"	Pinus flexilis James	Limber pine
Shrub	Vaccinium membranaceum Dougl.	Big whortleberry
"	Viburnum edule (Michx.) Raf.	Squashberry
Half-Shrub	Chimaphila umbellata (L.) Bart.	Princespine
Vine	Linnaea borealis L.	American twinflower
Per.Forb	Adoxa moschatellina L.	Muskroot
"	Arnica rydbergii Greene	Arnica
"	Aster forwoodii S. Wats	Aster
"	Aster sibiricus L.	Siberian aster
"	Heydysarum occidentale Greene	Western sweetvetch
"	Helianthemum bicknellii Fern	Frostweed
"	Hieracium albiflorum Hook	White hawkweed
"	Lechea intermedia Leggett	Pinweed
"	Pedicularis grayii A. Nels.	Grays pedicularis
"	Polygonum viviparum L.	Alpine bistort
"	Sagina saginoides (L.) Britt.	Artic pearlwort
"	Saxifraga cernua L.	Saxifrage
An.Forb	Linanthus septentrionalis Mason	
Grass	Calamagrostis purpurascens Gray	Purple pinegrass
"	Deschampsia caespitosa (L.) Beuv.	Tufted hairgrass
"	Oryzopsis pungens (Torr.) Hitchc.	Shorthorn ricegrass
"	Phleum alpinum L.	Alpine timothy
Gr.-like	Carex bella Bailey	Sedge
"	Carex leptalea Wahl.	Sedge
"	Carex microptera Mack.	Smallwing sedge
"	Carex obtusata Lilj.	Sedge
"	Luzula campestris (L.) DC.	Field woodrush

V. DISCUSSION

This regional profile report has identified, delineated, and characterized the major ecosystems of the Northern Great Plains within the limitations of time and available data. Sixteen ecosystems were identified and mapped to a scale of 1:1,000,000. Unfortunately, the degree of detail available is too small to permit specific site evaluations. Much additional data are needed to complete the regional profile.

Before understanding the potential impact of surface mine disturbance on ecosystems, attention must be given to fundamental interactions among the biological and physical components. Little is known about the role played by insects and micro-organisms in ecosystem dynamics. Yet, these organisms are actively present and they affect the larger vascular plants and animals of each ecosystem. The same is true of producer-consumer relationships, energy flow, and other ecosystem processes. The NGPRP report recognizes the limitations in present knowledge of basic natural processes. Acquisition of additional basic data and further understanding are needed. To pursue various alternatives of resource development without first understanding the fundamental interactions among biotic and abiotic factors affecting these alternatives could lead to ecosystem suicide.

BIBLIOGRAPHY

Blocker, H. D. 1969. The impact of insects as herbivores in grassland ecosystems. In: R. L. Dix and R. G. Beidleman (eds.). The grassland ecosystem, p. 290-299. IBP, Grassland Biome. Colo. State Univ.

Brown, R. W. 1965. The distribution of plant communities in the badlands of southeastern Montana. 145 p. M.S. Thesis, Univ. Mont.

Brown, R. W. 1971. Distribution of plant communities in southeastern Montana badlands. Am. Midl. Nat. 85:458-477.

Dix, R. L., and R. G. Beidleman (eds.). 1969 The grassland ecosystem. 437 p. IBP, Grassland Biome. Colo. State Univ.

Gray, T. R. G., and S. T. Williams. 1971. Soil microorganisms. 240 p. Hafner Publ. Co., New York.

Humphrey, Robert R. 1962. Range ecology. 234 p. Ronald Press, New York.

Krebs, C. J. 1972. Ecology. 694 p. Harper and Row, New York.

Küchler, A. W. 1964. The potential natural vegetation of the conterminous United States. 154 p. Am. Geogr. Soc. Spec. Publ. 36.

Küchler, A. W. 1973. Problems in classifying and mapping vegetation for ecological regionalization. Ecology 54:512:523.

Morris, M. S. 1964. Natural vegetation of Montana. Map + 1 p. Univ. Mont., Sch. For.

National Academy of Sciences. 1969. Insect-plant interactions. 93 p. Wash., D.C.

Parker, F. D. 1973. Personal communication. USDA Agric. Res. Serv., Utah State Univ.

Rowe, J. S. 1961. The level of integration concept and ecology. Ecology 42:420-427.

Schumacher, C. M. 1972. Rare and endangered plants in South Dakota. USDA Soil Conserv. Serv. Range Tech. Note 13, 6 p.

Sukachev, V. N. 1960. Relationship of biogeocenosis, ecosystem, and facies. Soviet Soil Sci. 1960:579-584.

Tansley, A. G. 1935. The use and abuve of vegetation concepts and terms. Ecology 16:284-307.

Thilenius, J. F. 1971. Vascular plants of the Black Hills of South Dakota and adjacent Wyoming. USDA For. Serv. Res. Pap. RM-71, 43 p.

Thilenius, J. F. 1972. Classification of deer habitat in the ponderosa pine forest of the Black Hills, South Dakota. USDA For. Serv. Res. Pap. RM-91, 28 p.

Van Dyne, G. M. 1966. Ecosystems, systems ecology, and system ecologists. Oak Ridge Natl. Lab. ORNL-3957, 40 p.

Van Dyne, G. M. 1969a. Some mathematical models of grassland ecosystems. In: R. L. Dix and R. G. Beidleman (eds.). The grassland ecosystem, p. 3-26. IBP, Grassland Biome. Colo. State Univ.

Van Dyne, G. M. (ed.). 1969b. The ecosystem concept in natural resource management. 437 p. Academic Press, New York.

Weaver, J. E. 1954. North American prairie. 348 p. Johnsen Publ. Co., Lincoln, Nebr.

Weaver, J. E. 1968. Prairie plants and their environment. 276 p. Univ. Nebr. Press, Lincoln, Nebr.

Weaver, J. E., and F. W. Albertson. 1956. Grasslands of the Great Plains. Johnsen Publ. Co., Lincoln, Nebr.

Weaver, J. E., and F. E. Clements. 1938. Plant ecology. 601 p. McGraw-Hill Book Co., New York.